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U.S. Army Environmental Center

USAEC Report No. ENAEC-BC-CR-93104

# Final Feasibility Study For Explosive Washout Plant - Building 489 (OU6) at the Umatilla Depot Activity (UMDA)

Submitted to:

U.S. Army Environmental Center (USAEC),
Aberdeen Proving Ground,
Maryland



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Arthur D. Little, Inc.
Acorn Park
Cambridge, Massachusetts
02140-2390

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## 13. Abstract

This feasibility study (FS) for the Explosive Washout Plant (also designated as Building 489 or Site 5) Operable Unit at the U.S. Army Depot Activity at Umatilla (UMDA) has been prepared to evaluate potential remedial alternatives for mitigating explosive contamination at this site. It was conducted in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA). This FS provides a summary of the remedial investigation and risk assessment information developed by USAEC/Dames & Moore, remedial action objectives, identification and screening of potential remediation technologies, and a detailed evaluation of alternatives assembled from the most promising technologies. The alternatives evaluated in detail are No Action, Sump Cleanout and Controlled Access, Hydroblasting, Hot Gas Decontamination and Demolition and Disposal. Each of the alternatives (except No Action and Sump Cleanout/Controlled Access) also include pretreatment steps (such as solvent flushing of process equipment and solvent wiping metal surfaces) and post treatment by demolition/disposal. The alternatives were evaluated for overall protection of human health and the environment; compliance with applicable or relevant and appropriate requirements (ARARs); long-term effectiveness; reduction of toxicity, mobility, and volume; short-term effectiveness; implementability; and cost. The No Action alternative failed to provide overall protection of human health and the environment and did not meet ARARs. With the exception of the No Action alternative, all the alternatives meet requirements for overall protection of human health and the environment, compliance with ARARs, short-term effectiveness and implementability. Of all the alternatives, the least costly (controlled access) provided adequate effectiveness and reduction in toxicity, mobility or volume. The most costly, hot gas decontamination, provided the greatest long-term effectiveness. The remaining two alternatives, hydroblasting and demolition/disposal, provided an intermediate reduction in toxicity, mobility and volume at a cost between that for hot gas decontamination and controlled access.

# Final Feasibility Study for the Explosive Washout Plant Operable Unit (Building 489) (OU6) at the Umatilla Depot Activity (UMDA)

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Program Manager, Robert Lambe — Date

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## Acronyms and Abbreviations

| | |
|---|---|
| ADA | Ammunition Demolition Activity |
| AMCCOM | Armament Munitions and Chemical Command |
| APC | Air pollution control |
| ARARs | Applicable or Relevant and Appropriate Requirements |
| ATSDR | Agency for Toxic Substances and Disease Registry |
| BACT | Best available control technology |
| BCF | Bioconcentration factor |
| BRAC | Base Realignment and Closure |
| BW | Body weight |
| °C | Degrees Celsius |
| CA | Concentration in air |
| CAG | Carcinogen Assessment Group, EPA |
| CBG/WB | Cemented basalt gravel/weathered basalt |
| CDI | Chronic daily intake |
| CE | Combustion efficiency |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CF | Conversion factor |
| CFR | Code of Federal Regulations |
| CNS | Central nervous system |
| CO | Carbon monoxide |
| CS | Concentration in soil |
| CW | Concentration in water |
| CWA | Clean Water Act |
| 2,4-DNT | 2,4 Dinitrotoluene |
| 2,6-DNT | 2,6 Dinitrotoluene |
| DNB | 1,3 - Dinitrobenzene |

| | |
|---|---|
| DoD | Department of Defense |
| DRMO | Defense Reutilization and Marketing Office |
| DOPP Kettle | Intermediate Processing Vessel between the Explosive Settling Tank and Pelletizer |
| DRE | Destruction and Removal Efficiency |
| ED | Exposure duration |
| EF | Exposure frequency |
| EPA | U.S. Environmental Protection Agency |
| EPIC | Environmental Photographic Interpretation Center |
| ET | Exposure time |
| FFA | Federal Facility Agreement |
| FI | Fraction ingested from contaminated source |
| FS | Feasibility study |
| HCl | Hydrochloric acid |
| HEAST | Health Effects Assessment Summary Tables |
| HI | Hazard Index |
| HMX | High melting explosive (1,3,5,7-tetranitro-1,3,5,7-tetrazacyclo-octane) |
| HRS | Hazard Ranking System |
| I | Intake |
| ID | Induced draft |
| IR | Ingestion or inhalation rate |
| IRIS | Integrated Risk Information System |
| $LD_{50}$ | Lethal dose to 50 percent of the study population |
| LDR | Land disposal restrictions |
| M | Million |
| MCL | Maximum contaminant level |

| | |
|---|---|
| µg/g | Micrograms per gram (parts per million) |
| µg/L | Micrograms per liter (parts per billion) |
| mg/kg | Milligrams per kilogram (parts per million) |
| MSL | Mean sea level |
| NB | Nitrobenzene |
| NCP | National Oil and Hazardous Substances Contingency Plan |
| NEPA | National Environmental Policy Act |
| NJDEP | New Jersey Department of Environmental Protection |
| NPL | National Priorities List |
| NSR | New source review |
| OAR | Oregon Administrative Rules |
| ODEQ | Oregon Department of Environmental Quality |
| ORNL | Oak Ridge National Laboratory |
| ORS | Oregon Revised Statutes |
| OSHA | Occupational Safety and Health Administration |
| OU | Operable Unit |
| PCB | Polychlorinated biphenyls |
| PCC | Primary combustion chamber |
| PIC | Products of incomplete combustion |
| PF | Potency factor |
| $pg/m^3$ | Picograms per cubic meter |
| PHRED | Public Health Risk Evaluation Data Base |
| PMP | Potential Migration Pathway |
| POHC | Principal organic hazardous constituents |
| PPLV | Preliminary pollutant limit value |

**Acronyms and Abbreviations (continued)**

| | |
|---|---|
| ppm | Parts per million |
| PRGs | Preliminary Remediation Goals |
| PSD | Prevention of significant deterioration |
| QA/QC | Quality Assurance/Quality Control |
| RA | Risk Assessment |
| RAC | Remedial Action Criteria |
| RAG | Remedial Action Goal |
| RAGS | Risk Assessment Guidance for Superfund |
| RAOs | Remedial Action Objectives |
| RCRA | Resource Conservation and Recovery Act |
| RDX | Royal Demolition Explosive (1,3,5-trinitro-1,3,5-triazacyclohexane) |
| RfD | Reference Dose |
| RI | Remedial Investigation |
| RI/FS | Remedial Investigation/Feasibility Study |
| ROD | Record of Decision |
| RTECS | Registry of Toxic Effects of Chemical Substances |
| SARA | Superfund Amendments and Reauthorization Act |
| SCC | Secondary combustion chamber |
| scfm | Standard cubic feet per minute |
| SF | Slope Factor (for risk assessment) |
| SPPPLV | Single Pathway Preliminary Pollutant Limit Value |
| TBC | To be considered |
| TCLP | Toxicity characteristic leaching procedure |
| TDS | Total dissolved solids |
| TSD | Treatment, storage, and disposal |
| Tetryl | N, 2,4,6-Tetranitro-N-methylaniline |

## Acronyms and Abbreviations (continued)

| | |
|---|---|
| THC | Total hydrocarbon concentration |
| TLV | Threshold Limit Value |
| TOC | Total organic carbon |
| TNB | 1,3,5-Trinitrobenzene |
| TNT | 2,4,6-Trinitrotoluene |
| TSS | Total suspended solids |
| TWA | Time-weighted average |
| UMDA | Umatilla Depot Activity |
| USATHAMA | U.S. Army Toxic and Hazardous Materials Agency |
| USAEC | U.S. Army Environmental Center (formerly USATHAMA) |
| USC | U.S. Code (Law) |

# Executive Summary

This feasibility study (FS) for the Explosive Washout Plant (also designated as Building 489 or Site 5 in the Remediation Investigation report) at the U.S. Army Umatilla Depot Activity (UMDA) in Hermiston, Oregon, has been prepared to evaluate potential remedial alternatives for mitigating explosive contamination of the Explosive Washout Plant and the Washout Water Sump.

Buildings contaminated with explosives are found at numerous Army installations. In the past, Army practice for decontamination of explosive contaminated buildings has included filling the building with combustible materials (wood and/or straw and oil) and burning down the building. From an environmental standpoint, this practice is obviously no longer considered generally acceptable. More recently; steam cleaning, solvent wiping and/or flaming have been used by the Army for decontamination of explosive contaminated buildings. A number of more conventional methods for building decontamination have been proposed by the Environmental Protection Agency (EPA)[9]. The U.S. Army Environmental Center, USAEC, (formerly the U.S. Army Toxic and Hazardous Materials Agency) has also sponsored development of a "Hot Gas Decontamination Process" that will effectively decontaminate structures (and equipment) for disposal or reuse.[4] The detailed evaluations in this FS focus on comparing several of the decontamination methods used by the Army and proposed in the EPA guide for building/structure decontamination process with the Sump/Cleanout Controlled Access and the No Action alternatives.

The FS was conducted in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA). Preparation of the FS was directed by USAEC for the Army as the owner/operator. Support was provided by the Environmental Protection Agency (EPA) Region X as the lead regulatory agency and the Oregon Department of Environmental Quality (Oregon DEQ) as the support regulatory agency. The relationship and responsibilities of the three parties are outlined in the Federal Facility Agreement (FFA) executed by the U.S. Army, UMDA, EPA, and Oregon DEQ[16].

Following completion of this FS, USAEC, in consultation with EPA and Oregon DEQ, will prepare a Proposed Plan (Plan) to describe the preferred remedy. The Plan will be issued by the Army, EPA, and Oregon DEQ for public review. Following receipt and consideration of comments on the Plan, the Army and EPA will document the selected remedy in the Record of Decision (ROD), with the concurrence of Oregon DEQ.

## Site Description

### *History*

UMDA is a 19,728-acre military facility located in northeastern Oregon, on the border of Morrow and Umatilla counties. It was established as an Army ordnance depot in 1941. Activities at the facility have included the storage of chemical-filled munitions and containerized chemical agents, and the disassembly, analysis, modification, reassembly, repacking, and storage of conventional munitions.

The UMDA facility is currently slated for realignment under the Department of Defense (DoD) Base Realignment and Closure (BRAC) program. If UMDA is approved for closure and the Army vacates the site, the facility could be released to private interests for

either light industrial or residential use. Industrial use is considered to be the most likely future use scenario.

From the 1950s until 1965, UMDA operated an on-site explosives washout plant similar to that at other Army installations. The plant processed munitions to remove and recover explosives using a pressurized hot water system. The principal explosives consisted of the following:

- 2,4,6-Trinitrotoluene (TNT)
- 1,3,5-trinitro-1,3,5-triazacyclohexane (commonly referred to as Royal Demolition Explosive or RDX)
- 1,3,5,7-tetranitro-1,3,5,7-tetrazacyclo-octane (commonly referred to as High Melting Explosive or HMX)
- N,2,4,6-Tetranitro-N-methylaniline (Tetryl)

In addition, the munitions contained small quantities of 2,4-dinitrotoluene (2,4-DNT), 2,6-dinitrotoluene (2,6-TNT), trinitrobenzene (TNB), dinitrobenzene (DNB), and nitrobenzene (NB) as either impurities or degradation products of TNT.

Operation of the plant included flushing and draining the explosives washout system weekly, and discharging the washwater to a washout water sump and then to two adjacent infiltration lagoons located to the northwest of the plant. The solids collected in the washout water sump were periodically removed, dried, and burned in the ammunition demolition activity (ADA) area.

### *Physical Setting*

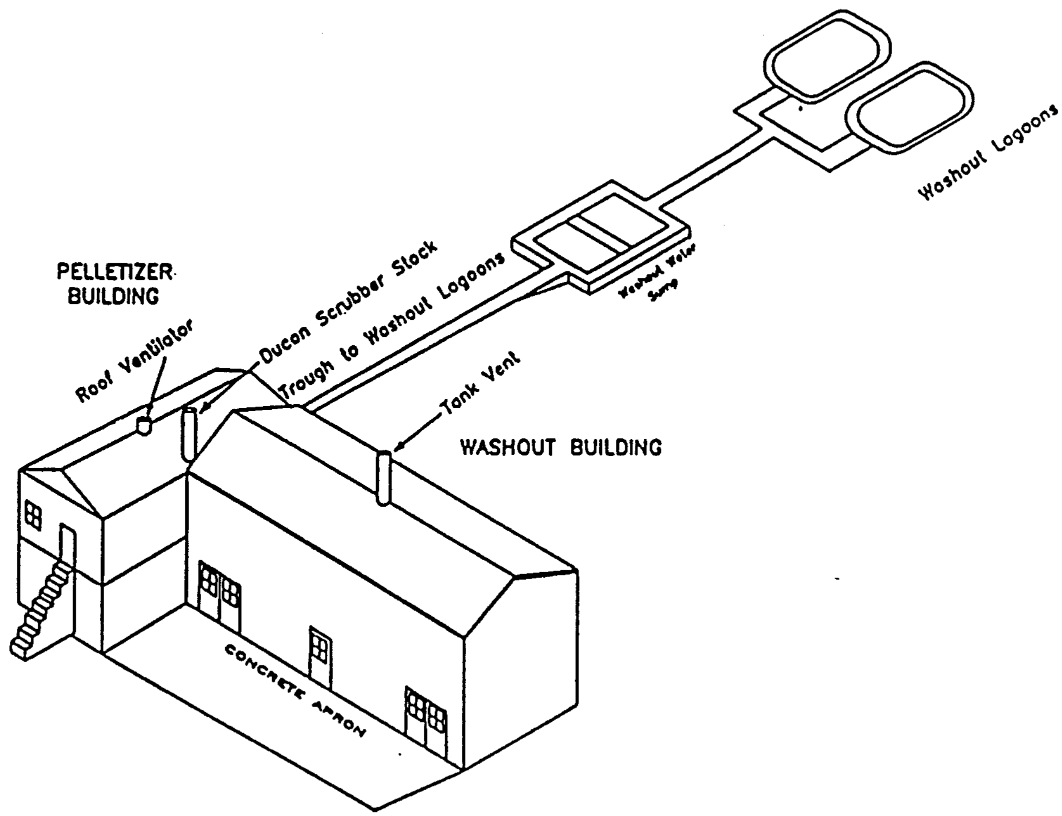
The Washout Plant is located on Rim Road at the top of Coyote Coulee and to the east of the Washout Lagoons. The Washout Plant is designated as Building 489 but actually consists of two adjoining buildings, the explosive washout building and the explosive pelletizer building, which share a common concrete (blast) wall. (Figure ES-1)

The explosive washout building is a one-story building with corrugated galvanized steel walls, a poured concrete floor, and a corrugated galvanized steel roof. The equipment in the washout building includes washout tanks, settling tanks, pumps, and process water heaters.

The washout building has a heavy deposit of pigeon droppings that cover the floor and equipment. The floor and washout water trough in the washout building section of the Washout Plant are in good condition; therefore, it is unlikely that there has been significant seepage of explosives from the current building into the soil. However, because the original building was demolished after a fire in the 1950s, the soil under the current building may be contaminated with explosives.

The pelletizing building is a two-story building sharing a concrete blast wall with the washout building, with the other three walls being constructed of corrugated aluminum sheet. The floor on both stories is constructed of poured concrete. The equipment in this building includes a pellet making tower, pellet dewatering screens, and a drying oven.

The washout water sump is constructed of poured concrete. The sump has a capacity of approximately 5,000 gallons and currently contains both contaminated water and explosive sludges.




EXPLOSIVE WASHOUT PLANT

| | | |
|---|---|---|
| PREPARED FOR: UMATILLA Washout Plant FS | | |
| DATE: APR. 1993 | SCALE: None | DWG. NO. 67062-045 |

TITLE: FIGURE ES-1: EXPLOSIVE WASHOUT PLANT AND WASHOUT WATER SUMP

## Nature and Extent of Contamination

In 1992, a remedial investigation (RI) of the Washout Plant was performed to determine the extent of explosive contamination of the building(s) so that appropriate plans for remediation (cleanup) could be developed.

The RI of the Washout Plant included three areas: the interior of the Washout Plant; the soil surrounding the buildings; and the overflow trough and sump. The remediation of the soil surrounding the washout plant, sump, and drain trough, will be conducted as part of the composting cleanup of the soils in the washout lagoons, using the same cleanup criteria as the lagoons. This is proposed because the soils around the plant are similar and have the same type of contamination as those in the lagoons. Because the planned composting cleanup of the lagoons has been described in the proposed plan and record of decision for the washout lagoons, and these documents are available to the public in the Hermiston library, Umatilla Depot, and EPA Oregon Operations Office, the composting remedy will not be described in this FS. However, the cleanup of the interior of the washout building, the sump, and the drain trough are included in this FS.

With assistance from UMDA retirees, the areas most likely to contain residual contamination from former plant operations were identified. These included various areas of the ceilings, walls, floors, and process equipment. Ten wipe samples were collected and analyzed for explosives in these areas to detect possible residual contamination.

All ten of the wipe samples were determined to contain very low concentrations (from less than 0.02 up to about 18.0 µg per sq. cm.) of one or more of the following explosives:

- TNT (trinitrotoluene)
- TNB (trinitrobenzene)
- HMX (High Melting Explosive)
- RDX (Royal Demolition Explosive)

Two surface water and two sludge samples were collected from the washout water sump (one from each chamber). High concentrations of explosives (up to 70% trinitrotoluene, TNT, by weight) were detected in the sludge, and low-to-moderate concentrations of the same explosives compounds were found in the water. The degree of contamination in the two sump chambers appears to be similar.

Explosives contamination was also found in soil samples taken from the area around the plant and the trough. Several of the samples have explosives at concentrations greater than 30 parts per million of TNT or RDX, which is the approved cleanup criteria for the washout lagoons soils, thus requiring treatment under the lagoon soil remediation project.

## Human Health Baseline Risk Assessment

During the development of the initial Human Health Baseline Risk Assessment prepared in June 1992[6], the development of risk characterizations for the Washout Plant was considered to be beyond the scope of the assessment, and therefore no quantitative risk

characterization was performed at that time. Qualitatively, however, the Army, EPA, and Oregon DEQ considered the Washout Plant to pose a future risk due to the toxicity of the contaminants in the plant and sump and the Army has, subsequently, prepared a risk assessment addendum [13] (Appendix B of this FS).

The Washout Plant itself presently poses little current risk to human health or the environment because access to the building site is prevented by current base restrictions. However, the UMDA facility is one of several installations scheduled for realignment (change in mission) and potential future closure under the Base Realignment and Closure (BRAC) program.

Upon closure, the facility could be turned over to another agency or the public. The human health hazards at that time, to persons entering the building, would be exposure to pigeon droppings (on the floors and equipment), and residual explosives on the building and equipment outer surfaces. A potential safety hazard would also exist if there is sufficient residual explosive inside any of the process equipment that could result in detonation.

Unlike the Washout Building, the residual water and explosive sludge remaining in the washout water sump poses a current human health risk and the sludge is a safety hazard because it contains sufficient explosive to be detonated.

Of the four explosives found to be present in the sump and Washout Plant, two (RDX and TNT) have been shown to cause cancer in laboratory animals. Because of the length of time that has elapsed since the Washout Plant became inactive, it is quite likely that there are some breakdown products of the explosives also present that were not detected and for which no health risk data have been developed.

## Remedial Action Objectives

There are no established federal cleanup standards for explosives-contaminated equipment or building materials that could be applied to the Washout Plant or sump. To develop proposed standards for cleanup of the Washout Plant and sump, it was first necessary to set cleanup objectives.

In the absence of federal cleanup standards for explosives, the following risk-based cleanup objective has been proposed for the Washout Plan and sump:

- Prevent human exposure to explosive contaminants present in excess of the cleanup objective of 3.5 and 4.6 μg/sq cm for carcinogenic explosives (RDX and TNT, respectively) and 0.5 and 460 μg/sq cm for noncarcinogenic explosives (TNB and HMX, respectively) on the (outer) accessible surfaces of process equipment, metal sheeting and concrete.

This cleanup level was developed in the Addendum to the Human Health Baseline Risk Assessment, Explosives Washout Plant, Umatilla Depot Activity, Hermiston, Oregon (Appendix B of this FS) and is based on a methodology developed by the New Jersey Department of Environmental Protection [14] for building interiors for either industrial or residential use. Future use of the Washout Plant is not expected to occur, but if it does, industrial use is considered to be the most likely type of future use.

To meet the risk-based objective, remediation of the washout water sump is required, but remediation of the building surfaces is not required. If the Washout Plant were used in the future for an industrial application, it would be necessary to clean out and remove the potentially contaminated process equipment from the building since Army safety regulations require that access to potentially reactive quantities of explosives be minimized.

Also, any explosives-contaminated equipment being released from Army control must be thermally treated to ensure that no reactive quantities of explosives remain. Although thermal treatment is the preferred method, other methods, such as washing, might also be used to comply with Army safety requirements.

Future potential use of the building may also require cleanup of the residual pigeon droppings and maintenance or removal of the asbestos insulation in the building.

In summary, to meet the risk-based objective, remediation (cleanup) of the sump will be required, but remediation of the building surfaces is not required at this time. Compliance with the Army safety and hygiene requirements with regard to the process equipment is met for the Washout Plant by ensuring that the current access restrictions remain in place.

## Detailed Analysis of Alternatives

The alternatives evaluated for remediation of the Washout Plant and washout water sump were as follows:

| | |
|---|---|
| Alternative 1: | No Action (Required by law to be considered) |
| Alternative 2: | Sump Clean-out/Controlled Access (Institutional Control) |
| Alternative 3: | Hydroblasting, Inspection, Demolition, and Disposal |
| Alternative 4A: | Hot Gas Decontamination, Total Demolition, and Disposal |
| Alternative 4B: | Hot Gas Decontamination, Partial Demolition, and Disposal |
| Alternative 5A: | Building Demolition, Inspection, and Disposal of contaminated materials |
| Alternative 5B: | Building Demolition, Inspection, Incineration of concrete rubble, and Disposal of materials |

All of the remedial alternatives that were developed and compared in the feasibility study (except Alternative 1) comply with the Remedial Action Objectives. For the alternatives that involve teatment of the building (those other than Alternatives 1 and 2), the possible detonable quantities of explosives in the process equipment, the asbestos, and pigeon droppings would be removed during a "pretreatment step" (discussed below) and include building demolition and disposal steps at the conclusion of the remediation.

The pretreatment operations would include:

- Removal of pigeon droppings and asbestos from the Washout Plant
- Removal of the sludge from the washout water sump and burning the sludge in the TNT burn trays at UMDA (as done in the past)
- Treatment of the washout water sump for residual explosive by flaming
- Rinsing out the process equipment with a solvent (such as alcohol) to reduce the levels of explosives within the equipment to below detonable quantitites
- Wiping off nonabsorbent surfaces (such as corrugated metal building siding and equipment surfaces) with solvent wet cloths to remove any residual explosives

- Removal of electrical wiring and controls from the Washout Plant

Each of the remedial alternatives is described briefly below.

**Alternative 1: No Action**
Capital Cost: None

Operating and Maintenance Cost: None

Net Present Value: None

Months to Implement: None

Both the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Oregon DEQ regulations require that the "No Action" alternative be evaluated for every site to establish a baseline for comparison. Under this alternative, the Army would take no further action at the site to prevent exposure to the explosives in the Washout Plant or the associated washout water sump. The existing public access restrictions would continue as long as the Army maintains control over UMDA.

**Alternative 2: Sump Clean-out/ Controlled Access**
Capital Cost: $55,000

Operating and Maintenance Cost: $7,800 per year for 30 years

Remedial Action Design and Planning: $90,000

Net Present Value: $220,000 (Total cost in today's dollars for current and future capital and operating costs for a period of 30 years)

Months to Implement: Remedial Action Design and Planning = 6 months; Construction = 2 months; Maintenance and Security = 30 years

This alternative complies with the risk-based and Army safety-based cleanup requirements as long as the Army retains control of the Washout Plant. One of the Alternatives 3 through 5B would be required in order to comply with Army safety requirements if the access restrictions cannot be maintained on the property. In Alternative 2, the water and sludge would be removed from the washout water sump and disposed of in the TNT burning trays in the ADA. The empty concrete sump would be flamed out to destroy any residual explosives and demolished and landfilled on-site.

The building would be secured and maintained for an indefinite period of time.

**Alternative 3: Hydroblasting, Inspection, Demolition, and Disposal**
Capital Cost: $150,000

Operating and Maintenance Cost (including pretreatment): $570,000

Remedial Action Design and Planning: $170,000

Net Present Value: $890,000

Months to Implement: Remedial Action Design and Planning = 7 months; Design/Construction = 2 months; Operation and Maintenance = 2 months

In hydroblasting, a high pressure water stream is directed at the surfaces to be decontaminated. The high pressure water stream (containing abrasive grit in this application) would be used to remove (explosive) contamination and paint from the surfaces of equipment as well as about one-half inch depth of concrete from all the concrete surfaces of the building. The water from the hydroblasting operation would be treated and discharged to the ground at UMDA; the combination of wet grit, paint, concrete dust, and explosive contaminants from hydroblasting would be sent off site for disposal by incineration followed by blending with cement and subsequent landfilling as a nonhazardous waste. The equipment from the building would be inspected for residual explosive contamination and landfilled at UMDA or off site. (It would probably be landfilled at UMDA if it tested negative to Webster's and Greiss reagent or off site in a Subtitle C landfill if it tested positive to Webster's or Greiss Reagent). The building would be demolished, the metal siding disposed of as scrap metal, and the concrete rubble landfilled, as a nonhazardous waste, at UMDA.

**Alternative 4A: Hot Gas Decontamination, Total Demolition, and Disposal**
Capital Cost: $410,000

Operating and Maintenance Cost: $660,000

Remedial Action Design and Planning: $150,000

Net Present Value: $1,220,000

Months to Implement: Remedial Action Design and Planning = 8 months; Design/Construction = 8 months; Operation and Maintenance = 4 months

In the hot gas decontamination process, hot gas is used to vaporize and desorb the (explosive) contaminants from the non-porous surface of equipment and/ or from the surface or subsurface of the porous materials, such as concrete. The hot gas from the building (or equipment enclosure) then passes through an afterburner (toxic fume combustor) where the contaminants removed from the building (or equipment) are destroyed. The hot gas supplied to the building (or equipment enclosure) would either be generated by a separate burner or by recycling hot gas from the afterburner.

The hot gas decontamination process has been demonstrated and shown to be effective in the removal of: TNT from concrete (both surface and internal) to below detectable levels at the Cornhusker Army Ammunition Plant; and in the removal of TNT, ammonium picrate, and smokeless powder from equipment to below detectable levels at the Hawthorne Army Ammunition Plant in Nevada.

In this alternative, the hot gas decontamination process would be used (after the general pretreatment steps) to decontaminate the process equipment and concrete floors and blast wall. Following hot gas decontamination, the process equipment would be removed from the Washout Plant, cut up, and disposed of as scrap metal. After complete building demolition, the concrete rubble would be disposed in a nonhazardous waste landfill on site and the sheet metal and structural steel disposed of as scrap metal.

***Alternative 4B: Hot Gas Decontamination, Partial Demolition, and Disposal***
Capital Cost: $410,000

Operating and Maintenance Cost: $560,000

Remedial Action Design and Planning: $150,000

Net Present Value: $1,120,000

Months to Implement: Remedial Action Design and Planning = 8 months; Design/Construction = 8 months; Operation and Maintenance = 4 months

This alternative would be identical to Alternative 4A, except that the washout building of the Washout Plant would not be demolished, but instead would be retained for future use. In a variation of Alternative 4B, only the process equipment (not the building) would be decontaminated by the hot gas process. The total cost for this variation of Alternative 4B would be about $1,060,000.

***Alternative 5A: Building Demolition, Inspection, and Disposal of Contaminated Materials***
Capital Cost: None

Operating and Maintenance Cost: $580,000

Remedial Action Design and Planning: $240,000

Net Present Value: $820,000

Months to Implement: Remedial Action Design and Planning = 10 months; Design/Construction = 1 month; Operation and Maintenance = 2 months

In this alternative, the Washout Plant would be demolished after the pretreatment operations, and no remediation of the concrete would take place before (or after) the demolition. As part of the pretreatment operations, the interior of the process equipment would have been flushed, with a solvent such as alcohol, to remove any large quantity of explosives, but traces of explosive might still remain inside the equipment.

For reasons of safety, the Washout Plant concrete floor would be broken up by blasting (using blasting mats) rather than by jackhammer after demolition of the building. The contaminated process equipment and concrete rubble would be disposed of in a landfill either at UMDA or off site after the process tanks had been cut open to verify they contained no more than traces of residual explosives.

The structural steel and metal siding and roofing (which were cleaned up during pretreatment operations) would be disposed of as scrap metal.

### *Alternative 5B: Building Demolition, Concrete Treatment, Inspection and Disposal of Materials*
Capital Cost: None

Operating and Maintenance Cost: $1,000,000

Remedial Action Design and Planning: $180,000

Net Present Value: $1,180,000

Months to Implement: Remedial Action Design and Planning = 10 months; Design/Construction = 2 months; Operation and Maintenance = 6 to 9 months

Alternative 5B would be the same as Alternative 5A except that the concrete rubble from the demolition of the buildings would be burned in a rotary kiln brought on site at UMDA so the decontaminated concrete rubble could be landfilled in a non-hazardous waste landfill on site at UMDA.

## Evaluation of Alternatives

The nine NCP evaluation criteria described in Table ES-1,were used in evaluating each of the remedial alternatives. A summary of the evaluation of the alternatives against these criteria is presented in the following discussion (and shown in Figure ES-2).

### *Overall Protection of Human Health and the Environment*
There is, currently, no known risk to the environment and minimal risk to human health due to the Washout Plant because of the access restriction to the building and the low level of explosive contamination within the building. In contrast, the washout water sump poses both an environmental and human health hazard, making Alternative 1 unacceptable. All of the remaining alternatives (2, 3, 4A, 4B, 5A and 5B) would be protective of human health and the environment, both in regard to the Washout Plant and the associated washout water sump.

### *Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)*
All of the alternatives comply with the ARARs for the Washout Plant. The measured explosives concentrations in the Washout Plant are below the risk-based cleanup goals. The state of Oregon's requirement is to clean up to background where feasible and cost effective, and if not, to attain risk-based cleanup standards. Background for explosives in the Washout Plant is essentially zero, or below detection limits. Only Alternatives 4A, 4B, and 5B could be expected to destroy all the explosives in the Washout Plant. But these alternatives involve a cost of nearly $1,000,000 more than is needed to comply with the risk-based cleanup goals. Compliance with Army safety requirements is assured by all the alternatives except Alternative 1.

**Table ES-1: NCP Evaluation Criteria for Remediation (Cleanup) Alternatives**

- Overall protection of human health and the environment addresses how an alternative provides adequate protection to human health and the environment and describes how risks posed are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.
- Compliance with ARARs addresses whether or not a remedy will meet all of the applicable or relevant and appropriate requirements of other federal and state environmental statutes and/ or provide grounds for invoking a waiver.
- Long-term effectiveness and permanence refers to the magnitude of residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time once cleanup goals have been met.
- Reduction of toxicity, mobility, or volume through treatment is the anticipated performance of the treatment technologies that may be employed in a remedy.
- Short-term effectiveness refers to the speed with which the remedy achieves protection, as well as the remedy's potential to create adverse impacts on human health and the environment during the construction and implementation period.
- Implementability is the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement the chosen solution.
- Cost includes capital and operation and maintenance costs.
- State acceptance indicates whether, based on its review of the FS and proposed plan, the state concurs with, opposes, or has no comment on the preferred alternative.
- Community acceptance will be assessed in the Record of Decision (ROD) following a review of the public comments received on the FS report and the proposed plan.

# Figure ES-2: Comparative Analysis of Alternatives Against NCP Evaluation Criteria

| Criteria | Alternative 1 No Action | Alternative 2 Controlled Access | Alternative 3 Hydroblasting, Demolition and Disposal | Alternative 4A Hot Gas Decontamination, Total Demolition and Disposal | Alternative 4B Hot Gas Decontamination, Partial Demolition and Disposal | Alternative 5A Demolition and Disposal of Contaminated Materials | Alternative 5B Demolition, Incineration of Concrete Rubble and Disposal of Materials |
|---|---|---|---|---|---|---|---|
| Overall Protection of Human Health and the Environment | Worst | Good | Good | Best | Best | Good | Good |
| Compliance with ARARs | Worst | Good | Good | Best | Best | Good | Good |
| Long-Term Effectiveness | Worst | Neutral | Good | Best | Best | Good | Good |
| Reduction of Toxicity, Mobility or Volume through Treatment | Worst | Poor | Good | Best | Best | Poor | Good |
| Short-Term Effectiveness | Worst | Best | Good | Good | Good | Good | Good |
| Implementability | Best | Best | Best | Good | Good | Best | Best |
| Cost (Capital and O&M) | Best | Best | Good | Poor | Poor | Good | Poor |
| **Overall Rating** | Worst | Good | Good | Best | Best | Good | Good |

**Key**

● =Best ◓ =Good ◒ =Neutral ⊗ =Poor ○ =Worst

**Source: Arthur D. Little, Inc.**

### Long-Term Effectiveness and Permanence

Of all the alternatives, the greatest long-term effectiveness is offered by Alternatives 4A and 4B. All of the remaining alternatives except Alternative 1 (which has no long-term effectiveness) have adequate long-term effectiveness and permanence. Alternative 2 would have slightly less long-term effectiveness and permanence than the other remediation alternatives (Alternatives 3 through 5B) because of potential residual contamination within the equipment, but the major current risk, the washout water sump, would be remediated in this alternative as well as in all the other remediation alternatives.

### Reduction of Toxicity, Mobility or Volume through Treatment

Alternatives 4A and 4B would reduce toxicity, mobility, and volume of contaminants to the greatest extent. Alternatives 2, 3, 5A and 5B would not reduce toxicity in regard to the equipment, but Alternatives 3 and 5B would reduce the toxicity of the concrete rubble from the building. Of these alternatives, Alternatives 3 and 5B would also reduce the volume of contaminated material. All the alternatives (except 1) would reduce mobility of the explosive contaminants. Alternative 1 provides no reduction in toxicity, mobility, or volume of contaminated materials.

### Short-Term Effectiveness

All the remedial alternatives (excluding Alternative 1) can be implemented in a year or less. Because the risks during implementation would be very low, there is no significant difference among these remedial alternatives in terms of short-term effectiveness. There is, however, slightly less short-term risk associated with Alternative 2 than with the other remediation alternatives, because there would be no remediation activities associated with the building or equipment that could result in any release.

### Implementability

All of the alternatives are readily implementable from an administrative and technical standpoint. In terms of materials and services, however, Alternatives 4A and 4B would require additional time for construction and demonstration of the hot gas decontamination system.

### Cost

The least costly, but effective, remedial alternative is Sump Cleanout/Controlled Access (Alternative 2) with a net present value (the value of money today spent over a period of time in the future) of approximately $220,000. Alternatives 3 and 5A would have a total net present value of about $890,000 and $820,000 respectively while Alternatives 4A, 4B and 5B would have a total net present value of over $1 million each. A variation of Alternative 4B, hot gas decontamination of process equipment, but not the building, would have a net present value of about $1 million.

### Modifying Criteria

In accordance with RI/FS guidance[3] the final two criteria involving state and community acceptance will be evaluated following the receipt of state agency and public comments on the FS and the Proposed Plan. The criteria are as follows:

- State (Support Agency) Acceptance – Reflects the State of Oregon's preferences among or concerns regarding the alternatives.

- Community Acceptance – Reflects the local communities' apparent preferences among or concerns about alternatives.

The state's input and acceptance is incorporated during preparation of the final FS and proposed plan due to the state's required review of these documents as specified by the Federal Facility Agreement. Community acceptance is gauged during a 30-day review period on the final documents.

# 1.0 Introduction

This report presents the results of the Explosive Washout Plant, Building 489, Feasibility Study (FS) performed for the Umatilla Army Depot Activity (UMDA) Superfund Site near Hermiston, Oregon. This report was prepared by Arthur D. Little, Inc., for the U.S. Army Environmental Center (formerly the U.S. Army Toxic and Hazardous Materials Agency) under Task Order No. 2 for Contract No. DAAA15-91-D-0016. The FS has been conducted in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986 and its governing regulations, and the National Contingency Plan (NCP) 40 CFR Part 300.

Eight operable units (OUs) have been identified at the UMDA site based on the results of the Preliminary Assessment[1] and the Remedial Investigation (RI)[2]:

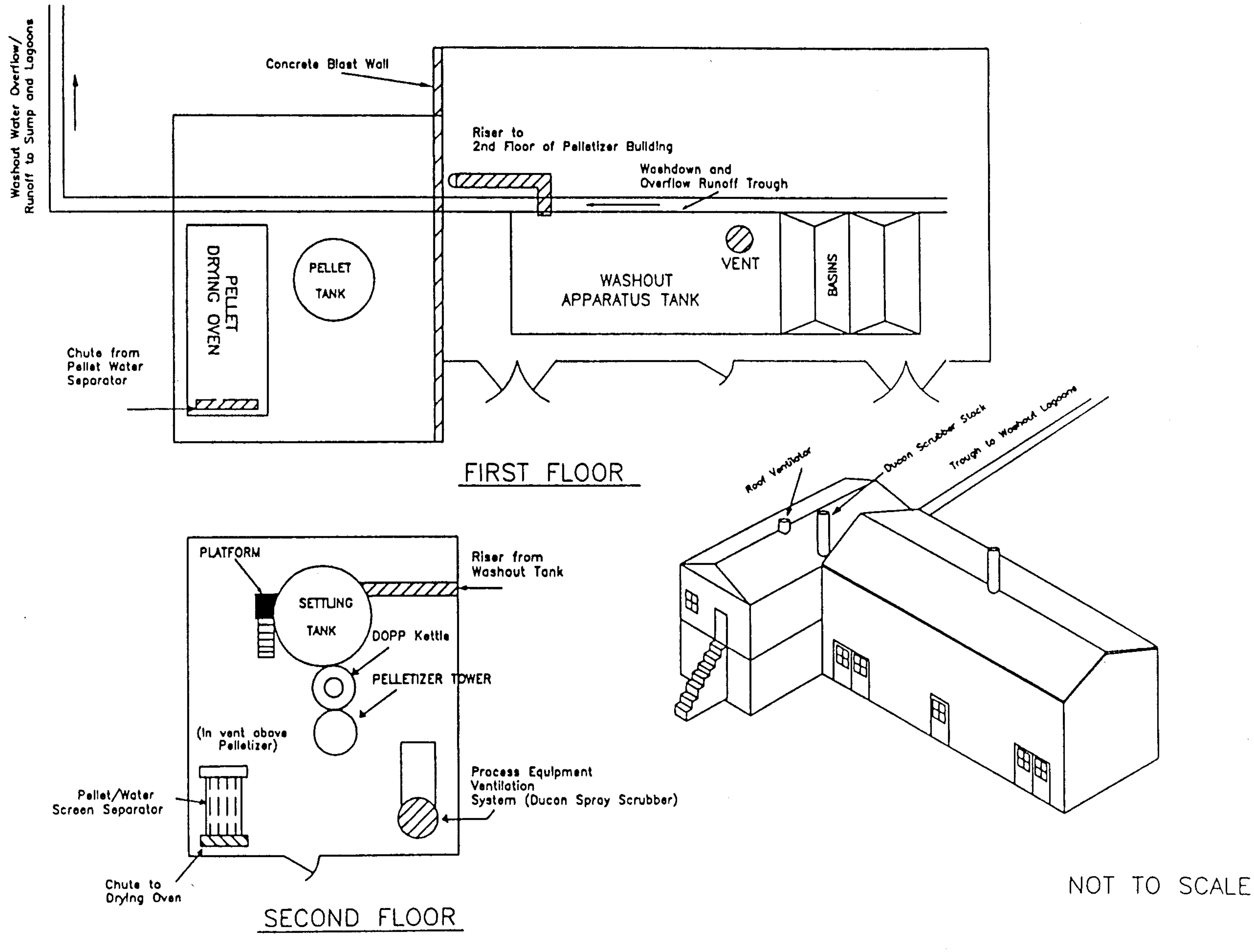
- Inactive Landfills
- Active Landfill
- Ground Water Contamination from the Washout Lagoons
- Ammunition Demolition Area (ADA)
- Miscellaneous Sites
- Explosive Washout Plant (Building 489)
- Washout Lagoon Soils
- Deactivation Furnace and Surrounding Soils

This FS is focused on the evaluation of remedial alternatives for the Explosive Washout Plant (Building 489), including the two process buildings and their associated equipment, the overflow runoff trough, and the sump. The other seven OUs are evaluated in separate FS reports.

## 1.1 Background

UMDA is a U.S. Army ordnance depot located near Hermiston, Oregon. From the mid-1950s until 1965, UMDA operated the Explosives Washout Plant onsite to remove and recover explosives from munitions. Figure 1-1 presents the layout of the Explosives Washout Plant; a description of the operations that took place in the Washout Plant is summarized below.

In the washout tank, hot water was sprayed into the base of the projectiles, which were held in racks, to melt and wash out the explosives. Molten explosive was collected in the bottom of the washout and settling/recirculation tanks and pumped (by steam educator) to the settling tank in the pelletizer/dryer section of the building. The water was decanted in this settling tank and returned to the washout section of the building, where it was typically reheated with steam and recycled to the washout tank. The molten explosive was fed through the DOPP kettle to the pelletizer tower. The pellet slurry from the bottom of the pelletizer tower was fed to a vibrating screen for dewatering and the dewatered pellets dropped into the dryer. The dried explosive pellets were removed from the dryer (for packaging) by a pneumatic conveyor system. Liquid discharges from the washout plant operations were collected in the two washout lagoons located to the west of Building 489.




| PREPARED FOR: UMATILLA Washout Plant FS | | | TITLE: FIGURE 1-1: EXPLOSIVE WASHOUT PLANT |
|---|---|---|---|
| DATE: FEB. 1993 | SCALE: None | DWG. NO. 67062-005 | |

# 1.0 Introduction

## 1.2 Purpose and Organization of Feasibility Study Report

### 1.2.1 Purpose of Feasibility Study

The purpose of this FS is to evaluate potentially applicable technologies (usually grouped together as alternative actions) to decontaminate (remediate) sites (areas or structures) that are contaminated with toxic materials and pose a risk to human health or the environment. In this case, the site (Washout Plant and washout water sump) is contaminated with residual explosives.

The Washout Plant itself presently poses little risk to human health or the environment because access to the building site is limited by the Army. However, the UMDA facility is one of several installations scheduled for realignment (change in mission) and potential future closure under the Base Realignment and Closure (BRAC) program.

Although no access is currently allowed into the locked washout plant, potential future risks were estimated for the plant using industrial and unrestricted future land use scenarios. These risks are based on the assumption that UMDA could be authorized for closure following completion of the proposed chemical stockpile demilitarization program. If UMDA property then leaves Army control, human exposure to the washout plant could occur. Exposure information for a building interior is very limited. A draft procedure developed by the New Jersey Department of Environmental Protection was used to estimate the health risks. This procedure had also been used by the Army in the risk assessment for the U.S. Army Materials Technology Laboratory in Watertown, Massachusetts. With this procedure, the estimated risks for both future industrial or office use and for residential use were acceptable. No remedial action was then required to comply with the National Contingency Plan and CERCLA. However, in addition to the risk associated with the minor explosive contamination of the building, there is also the concern that the process equipment may contain pockets of concentrated explosives that may be considered an explosion hazard.

This FS follows the guidelines provided in the EPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* [3], including defining the Washout Plant contamination problems; formulating remedial action objectives for the building materials and the process equipment; and developing, screening, and evaluating remedial action alternatives. The results of this evaluation will be used by the Army, in consultation with the Environmental Protection Agency (EPA) and the Oregon Department of Environmental Quality (DEQ), to select and propose a preferred remedial action (Proposed Plan) for the Explosives Washout Plant and associated equipment. After the Proposed Plan is reviewed by the public, the Army and the EPA will formalize the remedial action decision in a Record of Decision (ROD) document with concurrence from DEQ. A similar process is being followed for the seven other OUs.

Buildings contaminated with explosives are found at numerous Army installations. To date, the standard method of remediating these buildings has been burning down the building or a combination of steam and solvent cleaning followed by demolition; however, there is concern that these technologies may not sufficiently remediate the explosive contaminated building or components for reuse or disposal in an Subtitle D landfill or for recycling as scrap. Because of these concerns, USAEC (formerly USATHAMA) performed demonstration tests on an innovative technology that uses hot gas to thermally volatilize explosives from building materials and process equipment with the subsequent incineration of these volatilized explosives in an afterburner[4,5].

Therefore, this FS includes an evaluation of hot gas decontamination in addition to the more established technologies of steam and solvent cleaning or demolition and disposal with no treatment. As a baseline for these technologies, the impact of taking "No Action" at the site is also presented. Other potentially applicable remedial technologies are discussed briefly in the technology identification and screening section.

The FS is also intended to satisfy the requirements of section 102(2)(C) of the National Environmental Policy Act of 1969 (NEPA). The FS evaluated both the short-term and long-term environmental impacts of several alternatives, including "No Action." In addition, the NEPA public review requirement will be satisfied through the CERCLA public review, which will take place after completion of the FS and Proposed Plan and prior to issuance of the ROD.

### 1.2.2 Organization of FS

As the first step in the FS process, existing data and information on UMDA and the Explosive Washout Plant (Building 489) were compiled, summarized, and interpreted. The data and information are presented in Section 1.3, Site Information. This background information serves to establish a historical perspective of the site and provide an understanding of the nature and extent of the contamination. In addition, the RI data were the basis for a baseline risk assessment, the results of which are also presented in Section 1.3.

Based on the interpretations and analyses of the site data, remedial action objectives were defined, and possible general response actions and associated remedial technologies were identified. The response actions and the remedial technologies were screened, first for general feasibility, and then in more detail on the basis of effectiveness, implementability, and cost. Those technologies that survived the screening were assembled into remedial alternatives. The remedial goals and objectives and the results of the screening analysis are presented in Sections 2.0, Identification and Screening of Technologies and 3.0, Development and Screening of Alternatives.

The four major alternatives assembled following the screening were evaluated in greater detail. A process for implementing each alternative was developed, and the alternatives were considered in terms of how well each would meet the evaluation criteria specified in the NCP. After the individual evaluations, the alternatives were compared against each other to identify strengths and weaknesses. These evaluations are presented in Section 4.0, Detailed Analysis of Alternatives.

## 1.3 Site Information

This section describes the background and physical setting of UMDA and the Explosive Washout Plant (Building 489), including the nature and extent of the existing contamination in the Washout Plant. The primary references for this are the installation-wide Preliminary Assessment[1] and the RI[2]. Also included in this section is a summary of the Human Health Baseline Risk Assessment[6].

### 1.3.1 Site Description

***1.3.1.1 General.*** UMDA is located in northeastern Oregon on the border of Umatilla and Morrow counties near the city of Hermiston, as shown in Figure 1-2. It was established by the Army in 1941 as an ordnance facility for storing conventional munitions. Subsequently, the function of the facility was extended to include ammunition demolition (1945), renovation (1947), and maintenance (1955). In 1962, the Army began to store chemical-filled munitions and containerized chemical agents at the facility. UMDA continues to operate today as a munitions storage facility, and is scheduled to be involved in the U.S. Army's Chemical Demilitarization Program.

The facility occupies a roughly rectangular area of 19,728 acres; 17,054 acres are owned by the U.S. Government, while the remainder are controlled by restrictive easements that provide a safety zone around the facility. Although ownership of the latter is private, the easements grant perpetual rights to the U.S. Government, including the right to prohibit human habitation and to remove buildings. The owners retain the right to farm the lands and to graze livestock.

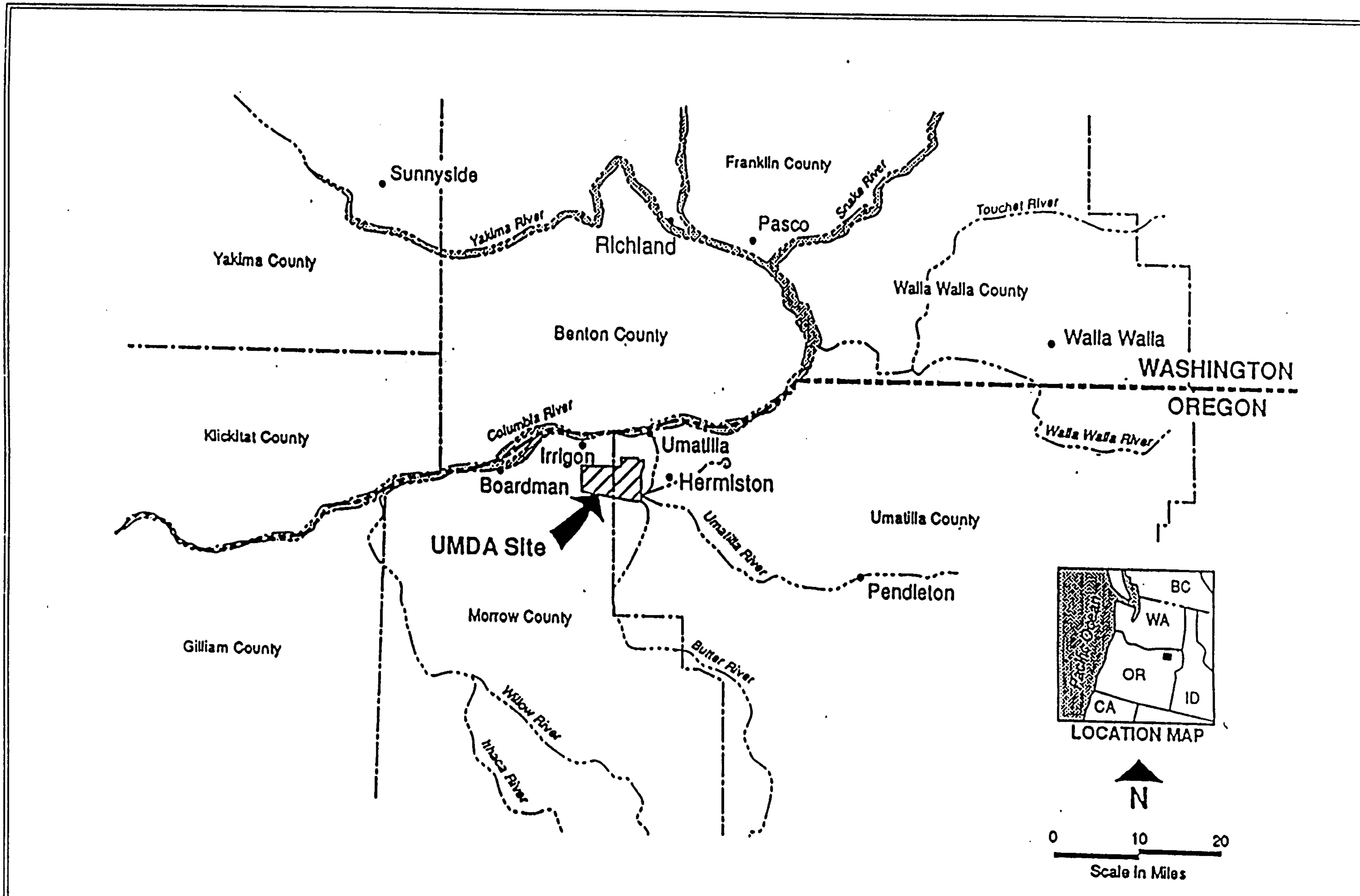
The UMDA facility is currently one of several installations scheduled for realignment under the Department of Defense (DoD) Base Realignment and Closure (BRAC) program. Under this program, the Army is required to realign the conventional ammunition storage mission to another Army installation. UMDA cannot be closed at this time due to the scheduled demilitarization of the chemical agent stockpile stored there. However, following the completion of that mission, the possibility exists that UMDA may be evaluated again for closure and will eventually vacate the site and relinquish ownership to another governmental agency or private interests. Although potential future use of the site beyond that time has not been determined, either light industrial or residential use is a possibility. Industrial use is considered to be the most likely future use scenario. Because of UMDA's uncertain future, the RI and this FS have considered future non-Army uses.

The Explosive Washout Plant is located on Rim Road at the top of Coyote Coulee and to the east of the washout lagoons (Site 4). The Washout Plant is designated as Building 489 but actually consists of two adjoining buildings (Figure 1-3):

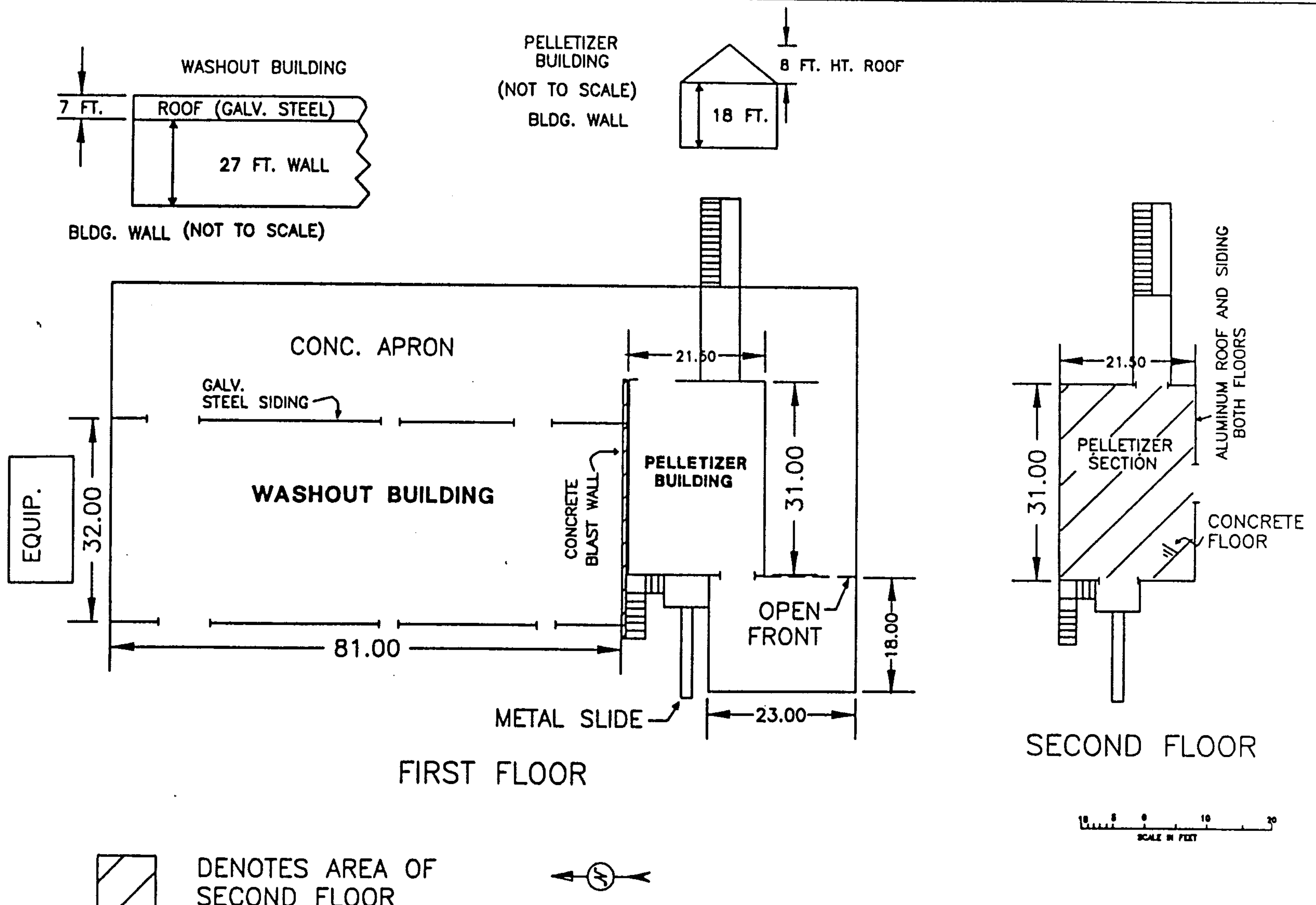
- The explosive washout building
- The pelletizer building

The washout building is a one-story building with galvanized steel walls and a concrete blast wall separating it from the pelletizing building, a poured concrete floor, and a corrugated steel roof. The building is approximately 81 feet long, 32 feet wide, and 26 feet high at the peak of the roof (Figure 1-4). The equipment in the building includes:

- Washout, recirculating and settling tanks
- Heat exchangers
- Pumps
- Overflow runoff trough
- Molten explosive riser to the pelletizing building
- Electrical controls and lighting fixtures.

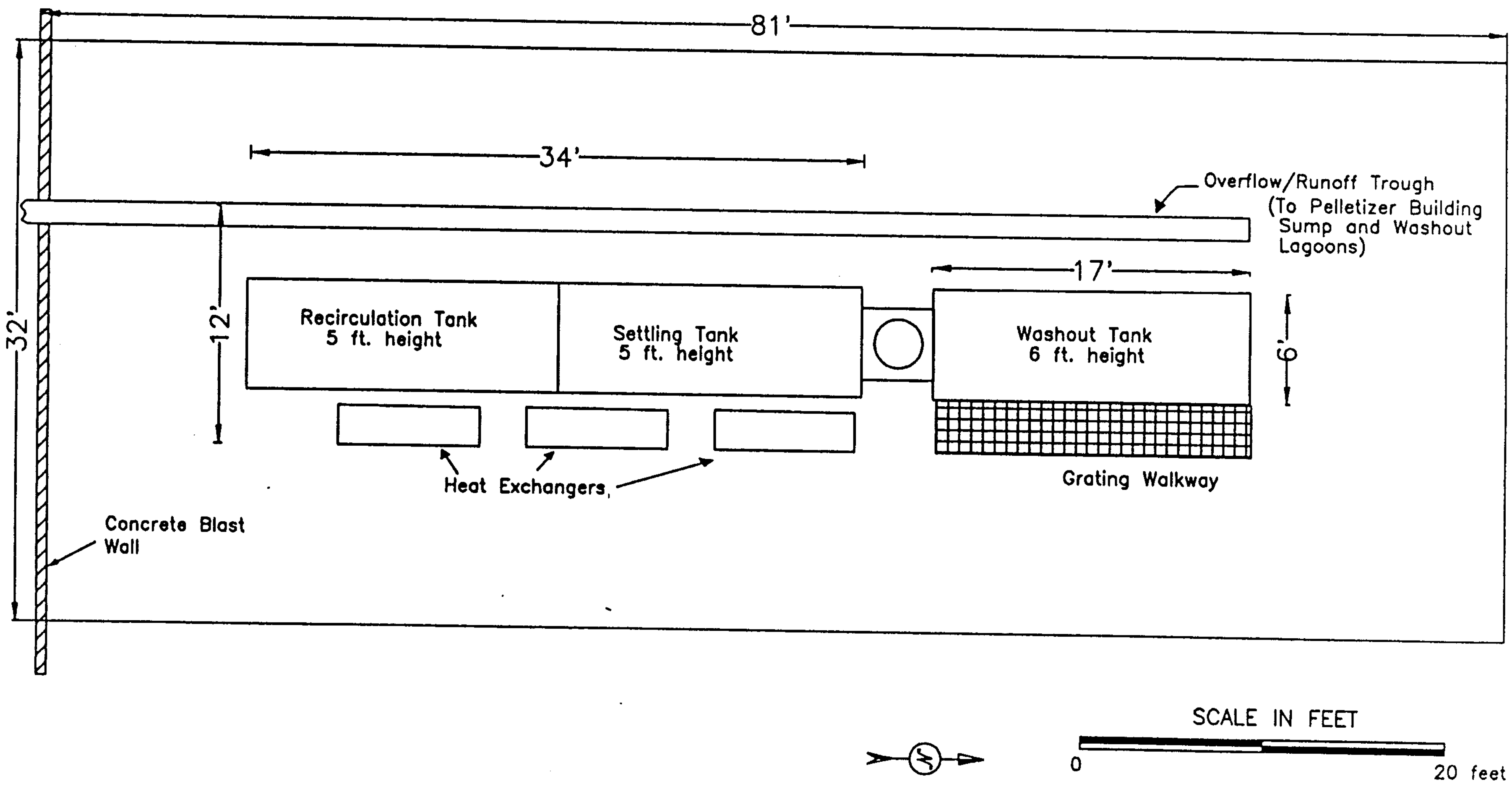



| PREPARED FOR: UMATILLA Washout Plant FS | | | SOURCE: Umatilla Depot Activity Washout Lagoons Soil Record of Decision (Sept. 1992) | TITLE: FIGURE 1-2: FACILITY LOCATION MAP UMATILLA DEPOT ACTIVITY |
|---|---|---|---|---|
| DATE: Feb. 1993 | SCALE: AS SHOWN | DWG. NO. 67062-010 | | |




Note: The Washout Plant consists of two adjoining buildings (Washout and Pelletizing Buildings separated by a Concrete Blast Wall)

| | | | | |
|---|---|---|---|---|
| PREPARED FOR: UMATILLA Washout Plant FS | | | DRAWN BY: (signature) | Arthur D Little | TITLE: FIGURE 1-3: EXPLOSIVE WASHOUT PLANT (BLDG. 489) - OVERVIEW |
| DATE: FEB. 1993 | SCALE: AS SHOWN | DWG. NO. 67062-011 | APPROVED BY: (signature) | | |




| PREPARED FOR: UMATILLA Washout Plant FS | | | DRAWN BY: (signature) | Arthur D Little | TITLE: FIGURE 1-4: EXPLOSIVE WASHOUT PLANT (BLDG. 489) WASHOUT SECTION TANK LAYOUT |
|---|---|---|---|---|---|
| DATE: FEB. 1993 | SCALE: As Shown | DWG. NO. 67062-012 | APPROVED BY: (signature) | | |

The washout building is in sound structural condition. It does, however, have a heavy deposit of pigeon droppings that cover the floor and equipment and would interfere with remediation activities. Most of the electrical controls (motor starters and temperature control units) are located on the building walls approximately 12 feet from the process equipment and appear to be in good condition and free from any explosive contamination. The main hot water and steam pipes (asbestos insulated) run along a walkway near the peak of the roof and well away from the process equipment.

The floor and wastewater trough in this section are in good, physical condition; therefore, it is unlikely that there has been any significant leakage of explosives from the current building into the soil. However, in the 1950s there was a fire in the previous building and as a result it was demolished. Therefore, the soil under the building could be contaminated from operations prior to the construction of the current building. If the soil under the Washout Plant is found to be contaminated after demolition of the Washout Plant, explosive contaminated soil would be remediated under the soil composting operable unit or one of the subsequent operable unit remediations.

The pelletizing building (Figure 1-5) is a two-story building sharing a concrete blast wall with the adjoining washout building; the other three walls are constructed of sheet aluminum. The floor on both stories is constructed of poured concrete.The building is approximately 31 feet long, 22 feet wide, and 26 feet high at the peak. Both floors of the pelletizing building have electrical switches and lighting. The equipment on the first floor consists of:

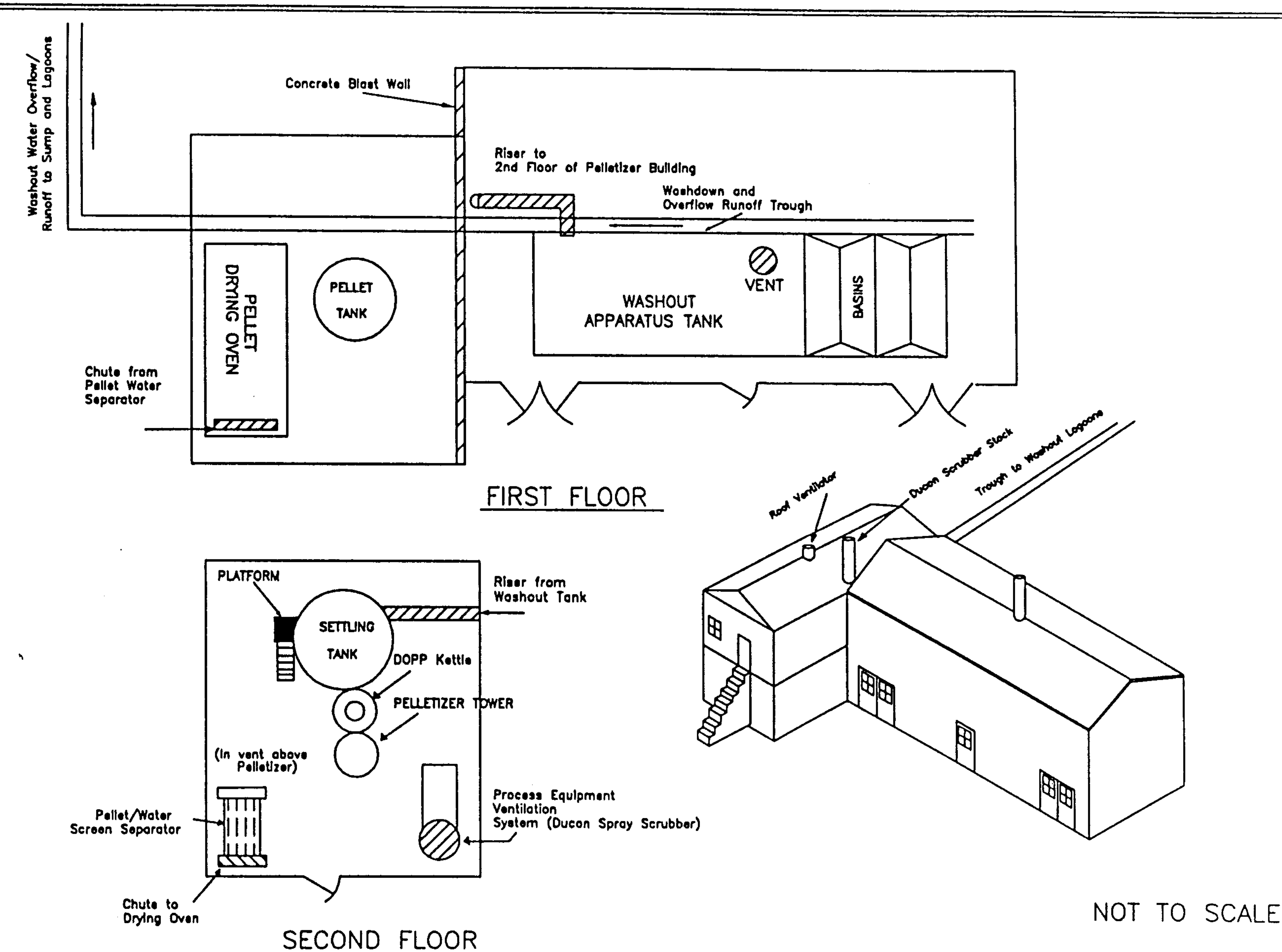
- Pellet wash tank
- Shaker/oven
- Electrical controls and lighting
- Overflow runoff trough

The equipment on the second floor consists of:

- Settling and mixing tanks
- Pelletizer
- Molten explosive riser to the pelletizing building
- Pellet/water separator vibrating screen
- Electrical controls and lighting
- Ventilation system

The pelletizing building is in poorer structural condition than the washout building and a small part of the roof is missing.

Both the washout building and the pelletizing building have pipes that are covered with insulation containing asbestos. The insulation appears to be in good condition in all cases and is not considered to pose a current hazard to personnel working in the area. In addition to the asbestos concerns, both buildings have also been inhabited by numerous pigeons, and this has caused a potential biological hazard due to the large quantity of pigeon droppings on the floor and the equipment.




| PREPARED FOR: UMATILLA Washout Plant FS | | | TITLE: |
|---|---|---|---|
| DATE: FEB. 1993 | SCALE: None | DWG. NO. 67062-005 | FIGURE 1-5: EXPLOSIVE WASHOUT PLANT |

The overflow runoff trough to the explosive wastewater lagoons and the sump located halfway between the Washout Plant and the lagoons will be included in the remediation of the buildings. The overflow trough is constructed of sheet metal and is approximately 200 feet long. The sump is constructed of poured concrete with a capacity of about 5,000 gallons and currently contains both contaminated water and an indeterminate volume of explosive sludge.

***1.3.1.2 Regional and Installation Setting.*** The portion of Oregon within an approximate 50-mile radius of UMDA includes parts of two geomorphic regions,[21] the Deschutes-Umatilla Plateau and the Blue Mountains (Figure 1-6). Both of these regions lie at least partly within the Umatilla River Basin.

The Deschutes-Umatilla Plateau where UMDA is located has relatively little relief. It gradually rises southward from elevations near 260 feet above mean sea level (MSL) at the Columbia River to approximately 800 feet at the foot of the Blue Mountains. Near-surface deposits underlying the Plateau consist primarily of Miocene basalt flows, basalt debris and silts deposited as alluvial fans, Quaternary silts and clays, and Quaternary alluvial gravel and sand deposited by catastrophic flooding of the Columbia River.

The edge of the Blue Mountains lies approximately 40 miles south and southeast of UMDA. The Blue Mountains reach elevations ranging from 3,500 to 6,000 feet. The mountains are considerably dissected by streams, which have eroded many steep-walled canyons. Near-surface deposits are primarily basalt and rhyolitic tuffs, with smaller areas of metamorphosed sedimentary and volcanic rocks of probable Triassic age, and diorite and other intrusive rocks of provable Cretaceous age.

The topography of the UMDA site, illustrated in Figure 1-7, can be naturally divided into three areas: Coyote Coulee, sloping lands east of the coulee, and rolling hills west of the coulee.

Coyote Coulee is a linear depression, about 0.25 mile wide, that trends north-northeast to south-southwest across UMDA. About one-third of UMDA lies east of Coyote Coulee.

The east side of the coulee is a steep escarpment about 50 feet high. Although the land rises westward from the bottom of the coulee, the top of the escarpment is at a higher elevation than any nearby land west of the escarpment along most of the length of the coulee. The coulee is thus asymmetrical, unlike an erosional canyon, where the elevation of the top of both canyon walls is generally the same. The top of the escarpment is near 650 feet in the north half of UMDA, but slopes southward to 600 feet near the southern boundary. The escarpment vanishes quite abruptly at the southern boundary.

East of Coyote Coulee, the surface slopes smoothly to the southeast, away from the escarpment, at a slope of approximately 50 feet per mile (ft/mi). The principal exceptions are a low hill near the southeast corner of UMDA and a nearly level area around the administration area. West of Coyote Coulee, the surface consists largely of rolling hills. The highest hill (677-foot elevation) is near the northern boundary, just west of Coyote Coulee. A broad area of high ground extends to the southwest from this hill; from the high ground, the surface slopes, with many irregularities, to the northwest and south.

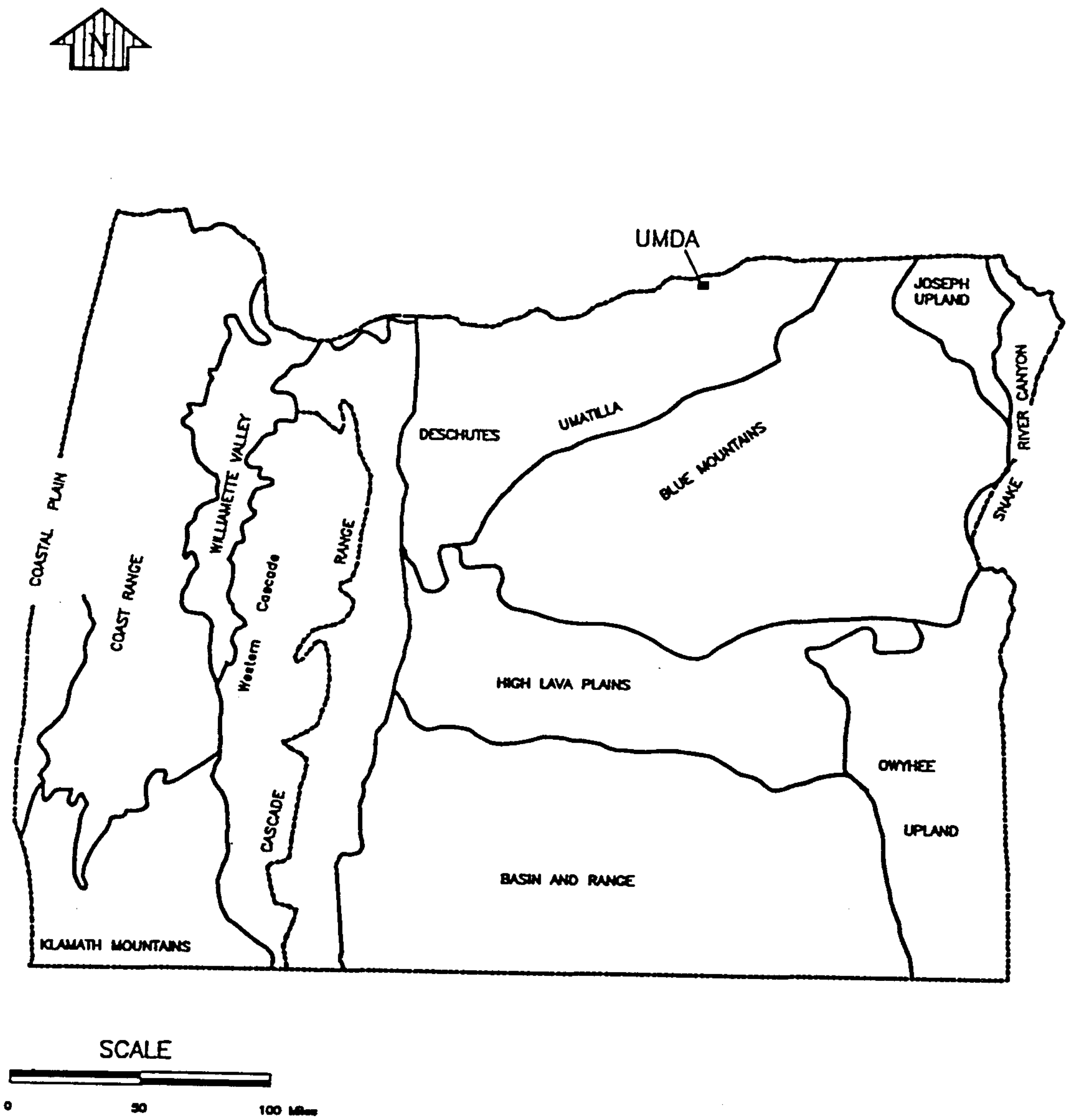
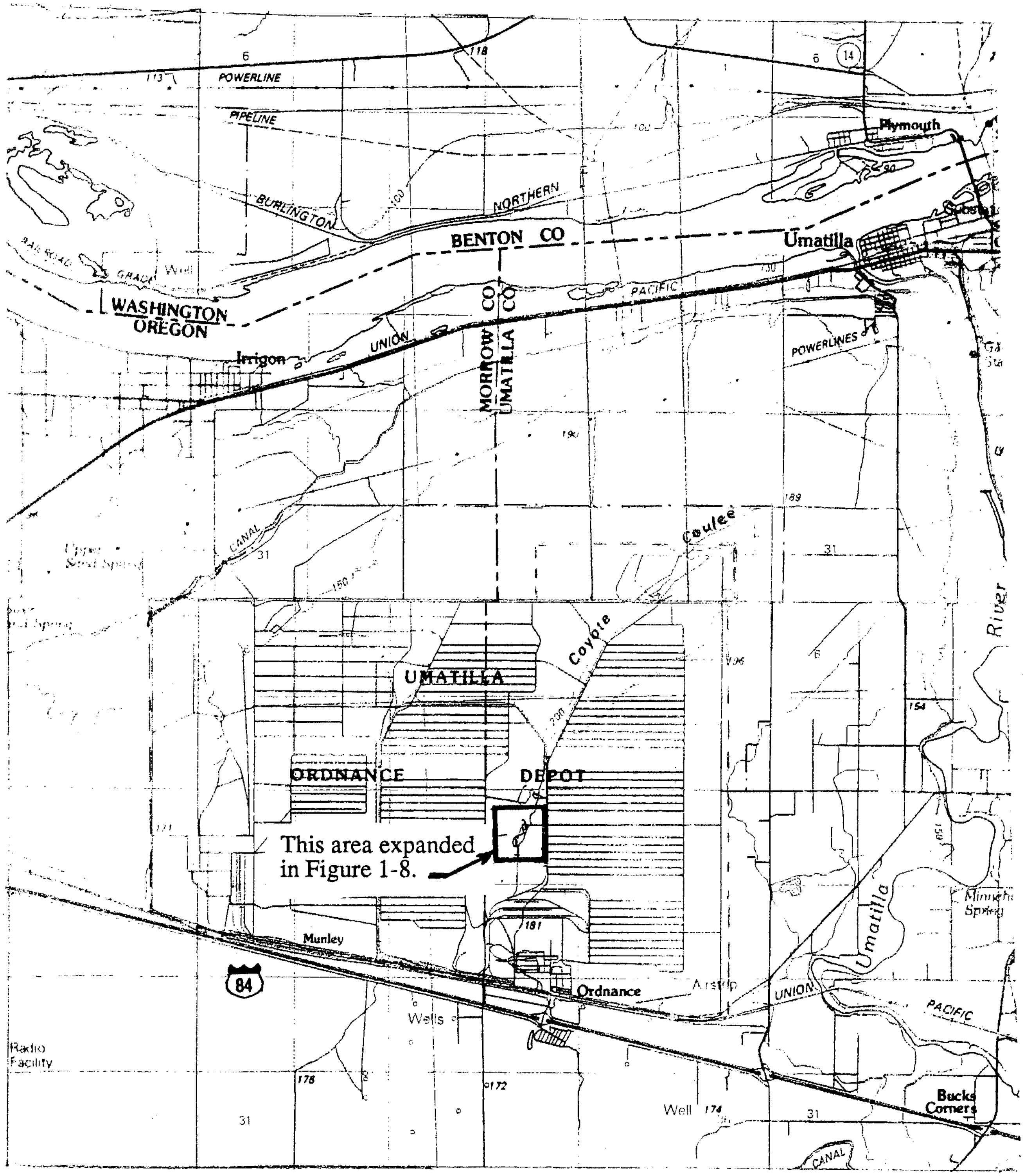



Figure I-6: Geomorphic Regions of the Area near UMDA. UMDA lies within the Deschutes - Umatilla Plateau.

| | | |
|---|---|---|
| TITLE: FIGURE 1-6: GEOMORPHIC REGIONS OF THE AREA NEAR UMDA | | |
| PREPARED FOR: UMATILLA | SOURCE: AFTER WALKER, 1977, AS MODIFIED FROM DICKEN, 1950 | |
| DATE: OCT.1992 | SCALE: AS SHOWN | DWG. NO. 67062-014 |

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Note: Horizontal Lines within UMDA area are igloo storage areas.

| PREPARED FOR: UMATILLA Washout Plant FS | | | FIGURE 1-7: TOPOGRAPHY OF UMDA |
|---|---|---|---|
| DATE: March 1993 | SCALE: 1:100,000 | DWG. NO.: 67062-022 | Source: USGS |

The northern half of the area west of Coyote Coulee has many linear hills and valleys, trending east-northeast to west-southwest, 10 to 20 feet high and up to 0.5 mile in length. These features may be large ripples associated with catastrophic flooding that occurred during drainage of Glacial Lake Missoula.

No natural streams occur within UMDA because of highly permeable soil and low rainfall. Drainage patterns are very poorly developed because of highly permeable soil, low precipitation, and the recent formation of the landscape. No direct information on stormwater drainage is available for most of UMDA. Stormwater runoff apparently does not travel far, except near the administration area, where runoff is collected by storm sewers. Many areas of closed drainage exist, particularly west of Coyote Coulee, with the largest about 100 acres in size.

***1.3.1.3 Meteorology.*** The following meteorological information is compiled from data from Gale Research Company (1985)[22] and U. S. Environmental Data Service (1975).[23] UMDA is located within the northern portion of the Columbia Basin, which enjoys a relatively mild climate. The temperature ranges from 24° to 90°F, with a mean annual temperature of 52.6°F. Normal daily average temperatures vary from 35°F in January to 70°F in July. The mild temperatures are a result of the moderating effect of the Pacific Ocean to the west.

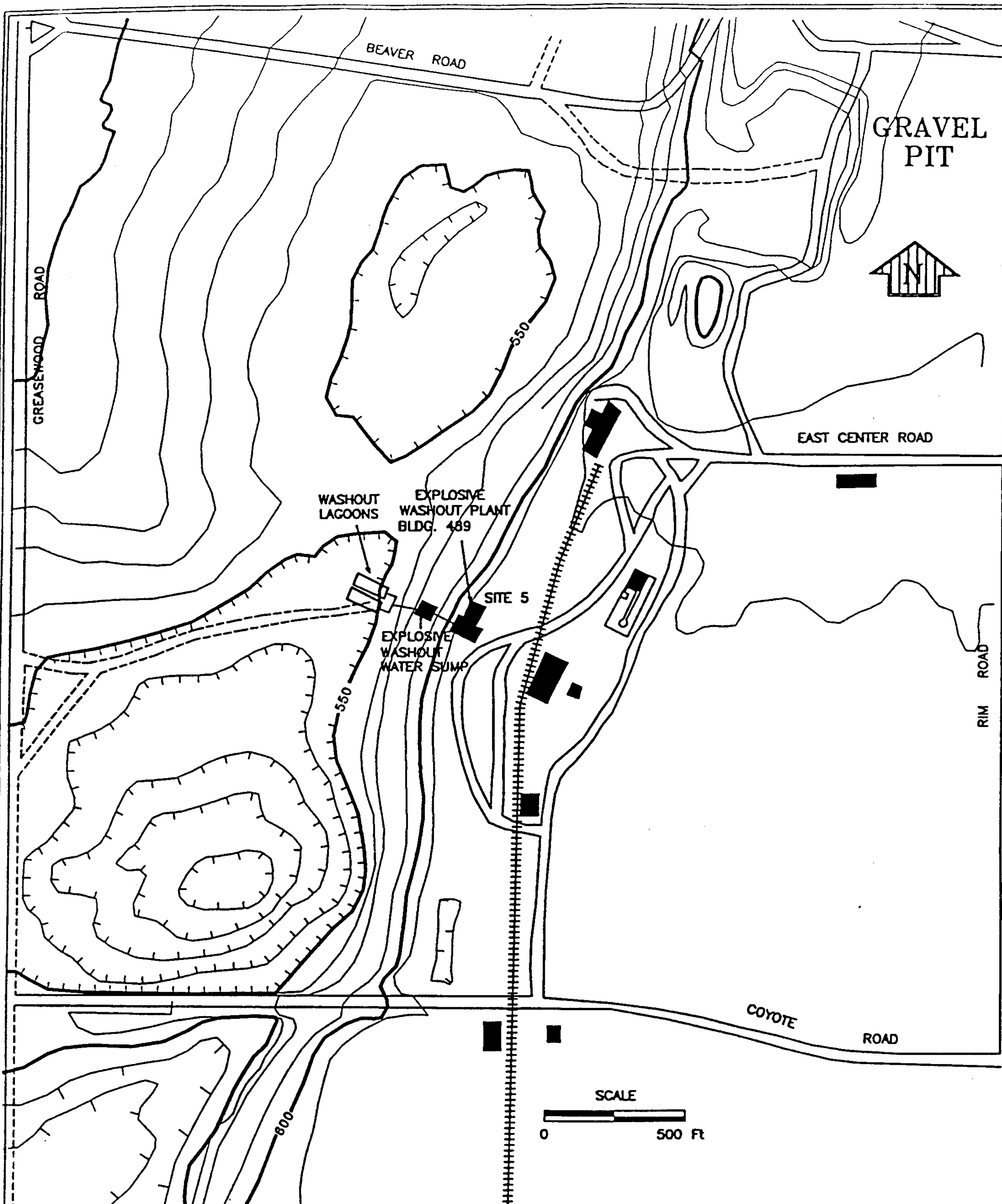
The majority of the moisture picked up from the Pacific Ocean falls on the western slopes of the Pacific Coast Range and the Cascades as the air mass moves eastward. Precipitation in the Hermiston area is relatively low, with an annual mean of 8.87 inches. Only about 10 percent of the annual precipitation falls in summer. For the month of January, the mean total precipitation is 1.91 inches; during July, the mean total is only 0.23 inch. The area receives an average of 9.8 inches of snow annually.

Mean relative humidity varies from 80 percent in January to only 35 percent in July. The humidity tends to be approximately 5 percent higher in the morning throughout the year. Consistent with the low summer humidity, 80 to 90 percent annual evaporation occurs between May and September.

### 1.3.2 Site History

The Explosive Washout Plant is designated as Building 489 (Site 5) and is located in the central portion of UMDA (Figures 1-7 and 1-8). The Washout Plant consists of two adjoining buildings, a large single story building where washout operations occurred, and a two-story pelletizing building where recovered explosives were separated, pelletized, and dried. Explosive washout operations conducted from the mid-1950s to the mid-1960s involved the removal of explosives from munitions, bombs and projectiles by means of hot water or steam-cleaning techniques. In the mid-1950s there was a fire in the building and a new building was constructed on the same site in the late 1950s.

Some of the munitions demilitarized at this location included 500- and 700-pound Composition B (TNT and RDX) bombs and 90-mm projectiles. The washout operations included sizable amounts of Composition B and TNT and reportedly some tritonal (TNT with aluminum flake). Therefore, the explosive compounds processed consisted of mainly:




| PREPARED FOR: UMATILLA Washout Plant FS | | | Source: Modified Figure 4-14 from Draft UMDA RI Report June 1992 | TITLE: FIGURE 1-8: LOCATION OF EXPLOSIVE WASHOUT PLANT |
|---|---|---|---|---|
| DATE: FEB. 1993 | SCALE: AS SHOWN | DWG. NO.: 67062-004 | | |

- 2,4,6-Trinitrotoluene (TNT)
- 1,3,5-trinitro-1,3,5-triazacyclohexane (commonly referred to as Royal Demolition Explosive or RDX)
- 1,3,5,7-tetranitro-1,3,5,7-tetrazacyclo-octane (commonly referred to as High Melting Explosive or HMX). Production grade RDX commonly contains small amounts of HMX impurity

In addition to these munitions, some explosives were handled in small quantities as impurities or degradation products of TNT, including: 2,4-dinitrotoluene (2,4-DNT); 2,6-dinitrotoluene (2,6-DNT); 1,3,5-trinitrobenzene (TNB); 1,3-dinitrobenzene (DNB); and nitrobenzene (NB).

Explosive Washout Plant operations typically involved the process scheme described below.

In the washout tank, hot water was sprayed into the base of the projectiles, which were held in racks, to melt and wash out the explosives. Molten explosive was collected in the bottom of the washout and settling/recirculation tanks and pumped (by steam educator) to the settling tank in the pelletizer/dryer section of the building. The water was decanted in this settling tank and returned to the washout section of the building, where it was typically reheated with steam and recycled to the washout tank. The molten explosive was fed through the DOPP kettle to the pelletizer tower. The pellet slurry from the bottom of the pelletizer tower was fed to a vibrating screen for dewatering and the dewatered pellets dropped into the dryer. The dried explosive pellets were removed from the dryer (for packaging) by a pneumatic conveyor system. Washout water from the reclaiming operation was reheated and returned to the washout tank. Excess washout water (from overflow or equipment washdown) flowed from the Washout Plant to the lagoons through a metal trough. The trough had a concrete, in-line, settling sump between the Washout Plant and the lagoons. During the washout operations the sump collected solids from the excess washwater and this sludge was pumped two or three times per week into a 500-gallon tank. The sludge was then transported to the ADA, and discharged into the northernmost burn trench at Site 19, Open Burning Trenches/Pads, and burned.

### 1.3.3 Nature and Extent of Contamination

The investigation of the Washout Plant (Building 498) included three areas: the interior of Building 489, the soil surrounding the building, and under the overflow trough and sump. The soil surrounding and under the building will not be considered in this FS; however, the interior of the building and the overflow runoff trough and sump are included in this FS. The following sections summarize the results of the RI for these three areas. Because of the similarity of the soil and contaminants around the washout plant to the lagoon soils, the Washout Plant soils are being remediated with the lagoon soils operable unit. This soil will then be remediated by composting as specified in the lagoons soils ROD dated September 1992. The alternatives analysis in this FS addresses the interior of the building and the washout through the sump, but not the soils around the washout plant.

***1.3.3.1 Interior of the Washout Plant.*** Other than the sampling completed during the RI, no other sampling has been performed in the Washout Plant. During the RI, an

investigation of the interior of Building 489 was performed to determine the extent of contamination. With assistance from UMDA retirees, the areas most likely to contain residual contamination from former plant operations were identified. This included the ceilings, walls, floors, and process equipment. Ten wipe samples were collected and analyzed for explosives in these areas to detect possible residual contamination. Locations of the wipe samples are described below and shown in Figure 1-9. The analytical results are summarized in Table 1-1.

- P5-1: Sample collected on the floor below the easternmost washout tank near the drainage valve. Possible spillage of contaminated water or water seepage from the drainage holes may have occurred here when the valves were changed or cleaned, or when the valve bladders were clogged.

- P5-2: Sample collected from the side of the washout tank below possible overflow area. Slight staining was observed on the metal tank wall in this area.

- P5-3: Sample collected on the floor below the westernmost washout tank near the drainage valve in a slight depression in the floor. This sample was collected for the same reason described for P5-1.

- P5-4: Sample collected in the drainage trough below the south wall separating the washout building from the pelletizer building. All drainage from the washout room should have flowed through this trough.

- P5-5: Sample collected from the corner of the hopper in the easternmost washout tank. A former UMDA employee stated that residues collected here were difficult to remove by steam cleaning.

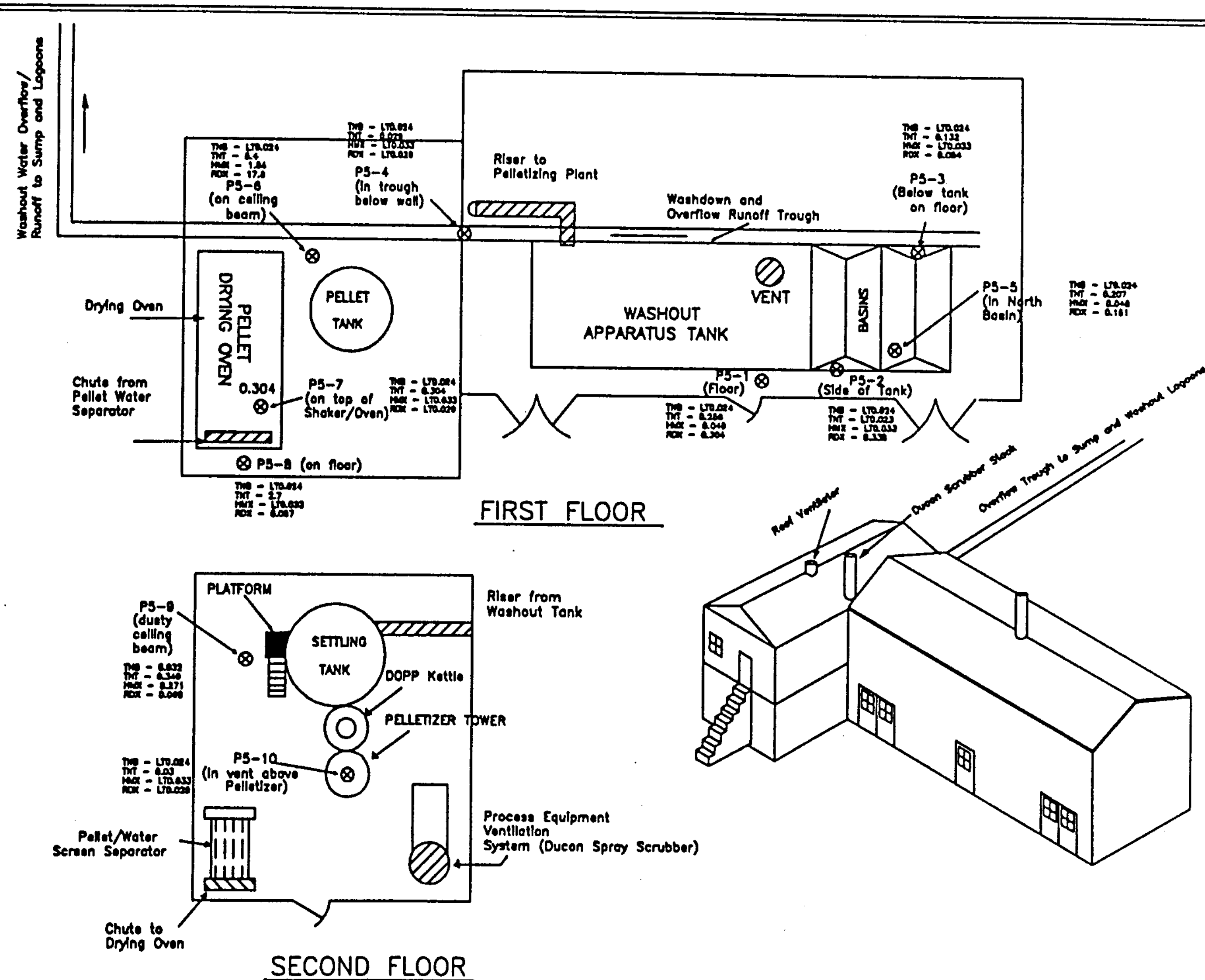
  P5-6: Sample collected on a ceiling beam on the lower level of the pelletizing building. Pellet drying took place in this area, and a former UMDA employee reported that the room had been dusty during washout operations. The sample location on the beam was discolored and dusty.

- P5-7: Sample collected on top of the housing for the shaker dryer on the lower level of the pelletizing building. This sample was collected near the drop chute leading from the pellet water separator located on the second floor.

- P5-8: Sample collected on the floor on the lower level of the pelletizing building. This sample was collected near the drop chute that led from the pellet water separator (second floor) to the shaker (ground floor). The drop chute consists of sheet metal connected to the shaker dryer by a flexible seal. A former UMDA employee observed what he believed to be pelletized Composition B explosives on the floor in this area.

- P5-9: Sample collected on a ceiling beam on the upper level of the pelletizing building. Pelletizing and water separation occurred on this level, and the room was reported to have been very dusty during operations.

- P5-10: Sample collected in a dust vent above the pelletizer.




Source: Dames and Moore RI Report (June 92)

| PREPARED FOR: UMATILLA Washout Plant FS | | | ⊗ Wipe Sample Locations (ug/sq.cm.) | CRL = Certified Reporting Limit | TITLE: FIGURE 1-9: EXPLOSIVE WASHOUT PLANT SAMPLE LOCATIONS AND ANALYTICAL RESULTS FOR WIPE SAMPLES |
|---|---|---|---|---|---|
| DATE: FEB. 1993 | SCALE: None | DWG. NO. 67062-013 | CRL TNT 0.023 ug/cm$^2$<br>CRL RDX 0.029 ug/cm$^2$ | LT = Less Than<br>CRL TNB 0.024 ug/cm$^2$<br>CRL HMX 0.033 ug/cm$^2$ | |

## Table 1-1: Analytical Results of Wipe Samples From Explosive Washout Plant (Bldg. 489)

| Sample No. | | P5-1 | P5-2 | P5-3 | P5-4 | P5-5 | P5-6 | P5-7 | P5-8 | P5-9 | P5-10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | | Floor near Washout Tank | Side of Washout Tank | Floor Under Washout Tank | Washout Water Overflow Trough | Inside Washout Tank | Top of Pelletizer Bldg. Beam | Top of Shaker Oven | Floor near Shaker Oven | Top of Pelletizer Bldg. Beam | Pelletizer Bldg. Vent |
| µg/sq. cm. Explosive | CRLs | | | | | | | | | | |
| 1, 3, 5 - TNB | 0.024 | LT 0.024 | LT. 0.024 | LT 0.024 | LT 0.024 | LT 0.024 | LT 0.024 | LT. 0.024 | LT 0.024 | 0.032 | LT 0.024 |
| 2,4,6 - TNT | 0.023 | 0.256 | LT 0.023 | 0.132 | 0.029 | 0.207 | 8.400 | 0.304 | 2.700 | 0.349 | 0.030 |
| HMX | 0.033 | 0.049 | LT 0.033 | LT 0.033 | LT 0.033 | 0.048 | 1.840 | LT 0.033 | LT 0.033 | 0.271 | LT 0.033 |
| RDX | 0.029 | 0.304 | 0.338 | 0.084 | LT. 0.029 | 0.151 | 17.600 | LT 0.029 | 0.057 | 0.064 | LT 0.029 |

LT = Less than
CRLs = Certified Reporting Limits

Source: Final RI Report [2]

All 10 of the wipe samples were determined to contain one or more of the following explosives (Figure 1-9):

- 2,4,6-TNT
- 1,3,5-TNB
- HMX
- RDX

Sample P5-9, collected on a ceiling beam on the upper level of the pelletizing building, was the only sample to contain all four explosives. Pelletizing and water separation occurred on this level, and the room was reported to have been very dusty during operations. Wipe sample P5-6, also collected on top of a ceiling beam in the lower level of the pelletizing building, contained the highest concentrations of three of the explosives. The high concentration was likely due to the beam being very dusty and never (or rarely) being cleaned. Pellet drying took place in this area, and the room was also reported to have been dusty during pelletizing operations.

The RI sampled only for explosives on the exposed surfaces in the Washout Plant and found contamination of several explosives. An additional area where larger concentrations of the explosives may possibly be found is inside the process equipment and piping. The process equipment was steam cleaned following the close of the washout operations, but some explosives, possible at reactive levels, may remain in the joints, corners, etc. of this equipment. To date no investigation has been performed to determine the extent of contamination there. The assumption will have to be made, therefore, that the equipment is contaminated internally. Since there is no potential human health exposure pathway for this internal explosive contamination, it is considered a potential explosion safety issue to be resolved by the Army rather than a health or environmental issue.

***1.3.3.2 Sump.*** Two surface water and two sludge samples were collected from the sump (one from each chamber). High concentrations of explosives were detected in the sludge, and low-to-moderate concentrations of the same explosives compounds were found in the water. The degree of contamination in the two chambers appears to be similar. Chemical analysis results for the sump water and sludge samples are presented in Tables 1-2 and 1-3, respectively.

As shown in Table 1-2, explosives detected in one or both of the water samples are 1,3,5-TNB, 2,4,6-TNT, HMX, and RDX, at total explosive concentrations ranging from 33.4 to 95.5 µg/L and with RDX being present in the highest concentrations. Table 1-3 shows that the same explosives were detected in the sludge at very high concentrations of total explosives; 402,000 µg/g and 712,000 µg/g. Because the total explosives concentration in these samples exceeds 10%, the sludge in the sump is considered to be reactive or detonable.

***1.3.3.3 Washout Plant Soils.*** During the RI, limited sampling was also conducted of the soil around the Washout Plant. The soil surrounding the Washout Plant was considered potentially contaminated from a number of sources. These sources include the temporary outdoor storage of old plant equipment, which was contaminated with

explosives residue; employees tracking contaminants from the building on their shoes; the possible release of liquid waste from building washout; and effluent along the washout water trough that was used to transport explosives-contaminated wastewater to the two lagoons located west of the plant.

Ten shallow soil samples and one field duplicate were collected from locations close to the washout building at depths to 18 inches. Six explosives, 1,3,5-TNB, 1,3-DNB, 2,4,6-TNT, 2,4-DNT, HMX, and RDX were detected in one or more of the samples, some at high concentrations. For example, 1,600 µg/g of RDX was detected in one sample and 9,900 µg/g of 2,4,6-TNT was detected in another sample, which contained all five explosives detected and is the location where red-stained soil was observed. No explosives were detected in two samples while all other samples contained at least one detected explosives compound. Based on these results, it appears that the shallow soil surround the washout plant is contaminated with explosives, possibly due to storage, liquid waste releases during building washout, or employees tracking contamination from the building.

Five of the six shallow soil samples collected adjacent to the metal trough leading to the lagoons also contained explosives. Specifically, 1,3,5-TNB, 2,4,6-TNT, HMX, and RDX were detected in three samples and the latter three explosives were detected in one sample. The highest concentrations detected were for RDX. Based on these results, it appears that he overflow of explosives-contaminated wastewater has impacted the soil along the metal trough.

In view of the results of these soil analyses, it appears that some of the soil around the Washout Plant and Washout water trough will require remediation under the lagoon soil operable unit remediation.

### 1.3.4 Baseline Risk Assessment

During the development of the Human Health Baseline Risk Assessment in June 1992[6], the development of risk characterizations for the Washout Plant was considered to be beyond the scope of the assessment, and therefore no quantitative risk characterization was performed at that time. However, additional work was performed in May 1993 to locate methods of estimating contaminant exposure inside buildings. A method developed by the New Jersey Department of Environmental Protection was used as the basis for an addendum [14] to the Human Health Baseline Risk Assessment (Appendix B of this document).

***1.3.4.1 Selection of Contaminants of Concern.*** Wipe samples collected from the building during the RI were analyzed for four explosives: 1,3,5-TNB; 2,4,6-TNT; HMX; and RDX. These explosives were designated contaminants of concern because they were detected in at lease one sample from the interior of the building or the equipment. In addition to these four explosives, DNT (2,4-Dinitrotoluene) was found in measurable amounts in the washout water sump sludge. DNT was, therefore, added to the list of contaminants of concern. Historical use of the Washout Plant was the primary rationale for excluding chemicals other than these five explosives.

**Table 1-2: Chemical Analysis Results from Standing Water in Washout Water Overflow Sump**

| | CRLs (µg/L) | Sample W4-1 (µg/L) | Sample W4-2 (µg/L) | Comparison Criteria (µg/L) |
|---|---|---|---|---|
| **Explosives** | | | | |
| 1,3,5-TNB | 0.626 | LT 0.626 | 1.18 | NSA |
| 2,4,6-TNT | 0.588 | 5.67 | 8.35 | NSA |
| HMX | 1.65 | 8.87 C | 7.78 C | NSA |
| RDX | 2.11 | 81.0 C | 16.1 C | NSA |
| **Total Explosives** | | **99.5** | **33.4** | |
| **Other Inorganics** | | | | |
| Nitrate/Nitrite | 10 | 280 | 550 | NSA |

LT = Less Than

NSA = No Standard Available in Media Analyzed

C = Confirmed Result in Second HPLC Column

CRLs = Certified Reporting Limits

Source: Remedial Investigation Report, Umatilla Depot Activity, August 1992 (2)

**Table 1-3: Chemical Analysis Results of Sludge in Washout Water Overflow Sump**

| | CRLs µg/g | Sample D4-1 µg/g | Sample D4-2 µg/g | Comparison Criteria µg/g |
|---|---|---|---|---|
| **Explosives** | | | | |
| 1,3,5-TNB | 0.488 | 210 | 370 | NSA |
| 1,3-DNB | 0.496 | LT 50 | LT 50 | NSA |
| 2,4,6-TNT | 0.456 | 400000 | 710000 | NSA |
| 2,4-DNT | 0.424 | LT 42 | 780 | NSA |
| HMX | 0.666 | 150 | LT 67 | NSA |
| Nitrobenzene | 2.41 | LT 240 | LT 240 | NSA |
| RDX | 0.587 | 1800 | 870 | NSA |
| **Total Explosives** | | **402,000** | **712,000** | |
| **Other Inorganics** | | | | |
| Nitrate/Nitrite | 0.6 | 18 | 3.33 | 9.9 |

LT = Less Than

NSA = No Standard Available in Media Analyzed

CRLs = Certified Reporting Limits

Source: Remedial Investigation Report, Umatilla Depot Activity, August 1992 (2)

As presented in Section 1.3.3, Nature and Extent of Contamination, all five explosives were found on the equipment, in the building, or in the sump. Therefore, they were considered the contaminants of concern for the FS.

***1.3.4.2 Exposure Assumptions.*** The washout water sump, and its contents of explosive waste sludge and explosives-contaminated wastewater, currently present both safety and human health and environmental risks. The risks include both a potential human health risk of exposure to facility personnel to the wastewater or sludge and the potential hazard of detonable quantities of explosive in the sump sludge.

The environmental risk from the sump is caused by rainwater collecting in the trough and the sump, overflowing, and carrying contamination into the Washout Lagoons. As part of the washout lagoon soil remediation project, there are currently plans to remove the washout water trough and cover the washout water sump. While this would prevent the further release of explosive contaminants to the environment and restrict access by facility personnel, it would not remediate the explosive sludge contained in the sump.

In the Explosive Washout Plant, the main source of exposure is the explosives-contaminated surfaces of the building and process equipment. Since there are currently no specific EPA or Army human exposure requirements for residual limits of explosives on surfaces, it has been proposed that the technical guidance developed by the New Jersey Department of Environmental Protection (NJDEP) be used in this feasibility study to determine cleanup criteria based on potential for human exposure and toxicity of the explosives.

The Draft Addendum to the Human Health Baseline Risk Assessment, Explosives Washout Plant[13] used the procedures developed by the NJDEP and assumes exposure through a combination of dermal contact, incidental ingestion, and inhalation of dust pathways in calculating the preliminary remediation goals (PRGs) for explosives in the Washout Plant. In this procedure it is assumed that 50% of the existing explosive surface contamination is absorbed by a person working in this area by a combination of the above exposure pathways over the total exposure time period. It was further assumed in these calculations that the exposure would occur during industrial rather than residential land use.

***1.3.4.3 Toxicity Assessment.*** The carcinogenicity of the chemicals of concern at UMDA was evaluated on the basis of cancer slope factors from the Integrated Risk Information System (IRIS) or Health Effects Assessment Summary Table (HEAST) databases. Slope factors were available for 2,4,6-TNT and RDX. The two other contaminants of concern do not have slope factors and were not evaluated for carcinogenicity. The potential for the development of noncancerous adverse health effects was evaluated on the basis of reference doses (RfDs) available from the IRIS and HEAST databases or in EPA guidance documents. The EPA toxicity values for each chemical of concern, including weight-of-evidence classification and cancer type (if carcinogenic), confidence level, critical effect(s), and uncertainty factors are provided in Table 1-4.

**Table 1-4: Health Effects Criteria for Contaminants of Concern in the Explosives Washout Plant**

| Contaminant of Concern | Slope Factor $(mg/kg\text{-}day)^{-1}$ | Source | Weight of Evidence Class. | Cancer Type | Reference Dose (mg/Kg-day) | Source | Critical Effect | Uncertainty Factor | Confidence Level |
|---|---|---|---|---|---|---|---|---|---|
| 1,3,5-Trinitrobenzene | | | | | 5.00E-05 | IRIS | Increased splenic weight | 10,000 | Low |
| 2,4,6-Trinitrotoluene | 0.030 | IRIS | C | Urinary bladder papillomas | 5.00E-04 | IRIS | Liver effects | 1,000 | Medium |
| HMX | | | | | 5.00E-02 | IRIS | Hepatic lesions | 1,000 | Low |
| RDX | 0.110 | HEAST | C | Hepatocellular carcinomas and adenomas | 3.00E-03 | IRIS | Inflammation of prostate | 100 | High |
| Dinitrotoluene | 0.068 | IRIS | B2 | Hepatocellular carcinomas, mammary, and renal | 2.00 E-03 | IRIS | Hepatic lesions | 100 | --- |

Sources:
EPA 1991: Integrated Risk Information System, September 1991.[17]
EPA 1991: Health Effects Assessment Summary Tables, Quarterly 1991[18]
EPA 1991: Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual, Supplemental Guidance, Standard Default Exposure Factors[19]
Small 1988: Residual Explosives Criteria for Treatment of Area P Soil, Louisiana Army Ammunition Plant[20]

Abbreviated qualitative profiles for the chemicals of concern are provided below:

- 1,3,5-TNB. Methemoglobin forms after oral administration in animals. Hyperemia, edema, and hemorrhages followed dermal application. Eye irritation followed ocular exposure.
- 2,4,6-TNT. Absorbed in the gastrointestinal tract, skin, and lungs. Reproductive effects reported in studies of animals included testicular atrophy and degeneration of the seminiferous tubular epithelium. Jaundice and hepatitis followed acute poisoning of humans. Chronic worker exposures produced cataracts, neurasthenia, polyneuritis, and other lesions of the central nervous system. Hematological effects include aplastic anemia and methemoglobinemia. TNT is also associated with sensitization dermatitis.
- HMX. Toxicity information is limited to a study of the lethal dose to 50 percent of the population in animals and 13-week feeding study in rats. Toxic effects were not noted in this risk assessment.
- RDX. Oral and inhalation exposure of humans to RDX has been associated with seizures, lethargy, nausea, insomnia, irritability, and memory loss. Oral exposure of animals has been associated with prostatitis, hepatotoxicity, myocardial degeneration, renal toxicity, and cataracts.

***1.3.4.4 Risk Characterization.*** The risk characterization was conducted by combining the toxicological data with the average daily intake. Potential incremental cancer risks are calculated by multiplying the daily intake averaged over the receptor's lifetime by the slope factor (SF). Hazard indexes are calculated for noncarcinogenic risks by dividing the average daily intake by the reference dose (RfD). Carcinogenic risks and noncarcinogenic hazard indexes are calculated for each pathway and then summed to yield the total site risk and hazard index.

The EPA does not currently have established guidance regarding the quantification of uptake due to potential exposure to (explosive) contaminated interior surfaces[13]. Therefore, a method developed by the NJDEP for estimating human intake of contaminants from contaminated surfaces[14] was used to estimate the human health risk associated with explosive contaminated surfaces. As noted in Section 1.3.4.2 of this FS, these estimates assume exposure by a combination of dermal contact, ingestion of dust, and inhalation of dust.

Using this NJDEP procedure (as described in Appendix B), a range of carcinogenic and noncarcinogenic risks were estimated based on using the maximum detected explosive concentrations and the 95% upper confidence limit (UCL) other than the maximum wipe sample concentration. These risk factors and hazard indexes are presented in Tables 1-5 and 1-6.

The risks calculated using the 95% UCL were selected as being representative of the risks presented by the Explosive Washout Building. The justification for considering the risks calculated for the 95% UCL other than the maximum wipe concentration rather than the maximum wipe sample concentration is that only one sample in a normally inaccessible location (over 6 feet height) was found to exceed the acceptable risk for carcinogens or hazard index.

**Table 1-5: Potential Carcinogenic Risks and Noncarcinogenic Hazards Due to Exposure to the Interior Building Surfaces of the Explosives Washout Plant (Building 489) using Maximum Detected Concentrations in Wipe Samples**

| Analyte | Carcinogenic Intake (mg/kg/day) | Slope Factor 1/(mg/kg/day) | Risk |
|---|---|---|---|
| 135TNB | * | * | * |
| 246TNT | 2.18E-04 | 3.0E-02 | 7E-06 |
| HMX | * | * | * |
| RDX | 4.56E-04 | 1.1E-01 | 5E-05 |
| **Total** | | | **6E-05** |

| Analyte | Noncarcinogenic Intake (mg/kg/day) | Reference Dose (mg/kg/day) | Hazard Quotient |
|---|---|---|---|
| 135TNB | 3.48E-06 | 5.0E-05 | 7E-02 |
| 246TNT | 9.07E-04 | 5.0E-04 | 2E+00 |
| HMX | 1.99E-04 | 5.0E-02 | 4E-03 |
| RDX | 1.90E-03 | 3.0E-03 | 6E-01 |
| **Total** | | | **3E+00** |

*Not calculated because contaminant is not considered a carcinogen or slope factor is not available.

Source: Dames & Moore[13]

**Table 1-6: Potential Carcinogenic Risks and Noncarcinogenic Hazards Due to Exposure to the Interior Building Surfaces of the Explosives Washout Plant (Building 489) using 95 Percent UCL on Arithmetic Mean of Concentrations other than the Maximum Wipe Samples**

| Analyte | Carcinogenic Intake (mg/kg/day) | Slope Factor 1/(mg/kg/day) | Risk |
|---|---|---|---|
| 135TNB | * | * | * |
| 246TNT | 2.53E-05 | 3.0E-02 | 8E-07 |
| HMX | * | * | * |
| RDX | 5.05E-06 | 1.1E-01 | 6E-07 |
| **Total** | | | **1E-06** |

| Analyte | Noncarcinogenic Intake (mg/kg/day) | Reference Dose (mg/kg/day) | Hazard Quotient |
|---|---|---|---|
| 135TNB | 2.59E-06 | 5.0E-05 | 5E-02 |
| 246TNT | 1.06E-04 | 5.0E-04 | 2E-01 |
| HMX | 1.20E-05 | 5.0E-02 | 2E-04 |
| RDX | 2.11E-05 | 3.0E-03 | 7E-03 |
| **Total** | | | **3E-01** |

*Not calculated because contaminant is not considered a carcinogen or slope factor is not available.

Source: Dames & Moore[13]

# 2.0 Identification and Screening of Technologies

## 2.1 Introduction

Under its legal authorities, EPA's primary responsibility at Superfund sites is to undertake remedial actions that are protective of human health and the environment. In addition, Section 121 of CERCLA establishes several other statutory requirements and preferences, including:

- A requirement that EPA's remedial action, when complete, must comply with all federal and more-stringent state environmental standards, requirements, criteria, or limitations, unless a waiver is invoked

- A requirement that a remedial action is selected that is cost effective and that utilizes permanent solutions and alternative treatment technologies or resources recovery technologies to the maximum extent practicable

- A preference for remedies in which treatment that permanently and significantly reduces the volume, toxicity, or mobility of the hazardous substance is a principal element

The remedial alternatives developed and analyzed in the FS are consistent with these Congressional mandates.

To complete this phase of the FS, remedial action objectives were developed based on the contaminants and media of concern, potential exposure pathways, and preliminary remediation goals that permitted a range of alternatives to be assembled. The preliminary remediation goals were selected based on the Applicable or Relevant and Appropriate Requirements (ARARs) developed for UMDA by Oak Ridge National Laboratory and the Human Health Baseline Risk Assessment.

Once the remedial action objectives were developed, the quantity and volume of contaminated media in the Explosives Washout Plant were estimated based on the results of the RI and risk assessment addendum[13]. With both an estimate of the amount of material in the Washout Plant requiring remediation and the remedial action objectives developed, a list of technologies was identified and screened to eliminate those technologies that were not applicable to the cleanup of this site.

## 2.2 Remedial Action Objectives

Remediation Action Objectives (RAOs) are set for each specific site taking into account the potential risks to human health and the environment for that site. The primary RAO for this site is to reduce the concentration of explosives at the site to below a level that poses an excess cancer human health risk of $1x10^{-5}$ and noncarcinogenic hazard index of 1. As part of developing the RAOs, Preliminary Remediation Goals (PRGs) for acceptable residual concentrations of contaminants (explosives for this site) are determined.

The development of the remedial action objectives is the most critical step in the FS process because these objectives are the basis by which the technologies and process options will be evaluated. In developing the remedial action objectives, four items are reviewed: (1) the contaminants of concern; (2) the nature of the contaminated media;

(3) the exposure routes by which humans and/or the environment can come into contact with these contaminants; and (4) acceptable levels of residual contamination (preliminary remediation goals).

As previously defined in more detail in Section 1.3.4.1, the contaminants of concern for the Washout Plant include the following:

- 1,3,5-trinitrobenzene (TNB)
- 2,4,6-trinitrotoluene (TNT)
- HMX
- RDX

An additional contaminant of concern, 2,4-dinitrotoluene (DNT), was also found to be present in the sludge of the washout water sump (Table 1-3), but the recommended method for remediation for this sludge for all the remediation alternatives is incineration in the ADA area and this remediation method should be applicable to this contaminant also. The methods for remediation of the (concrete) washout water sump would include excavation and hydroblasting or thermal treatment of the sump.

The media of concern in the Washout Plant include:

- Concrete floors and blast wall
- Structural steel and sheet metal siding
- Process equipment (tanks, pumps, heat exchangers, and piping)
- Electrical controls and motors

The exposure pathways assumed in calculating the PRGs for contaminated surfaces in the Washout Plant included dermal contact and ingestion or inhalation of contaminated dust.

The PRGs are usually based on chemical-specific Applicable or Relevant and Appropriate Requirements (ARARs) including health-based standards or health risk factors. For the contaminants of concern found in the Washout Plant, the PRGs for all of the media surfaces in the Washout Plant were calculated (Appendix B) using the methodology developed by the NJDEP (Table 2-1). Remedial action goals were not developed for internal contamination of porous materials, such as the concrete, since past experience (at Cornhusker AAP[4]) indicates that most of the contamination is present at the surface; and, secondly, the contamination within the porous material is, in reality, encapsulated, greatly reducing the potential for human exposure or environmental release. Likewise, any residual explosive within the process equipment (heat exchangers, pumps, or piping) poses little potential for human exposure or environmental release as long as it is not accessed, so this would be an explosion safety hazard rather than an environmental issue.

Nevertheless, for many of the alternatives, the determination of ARARs for some of the media in the building was complicated by the lack of clearly defined Department of Defense (DoD) cleanup criteria for releasing explosive contaminated materials such as process equipment and metal sheeting to the public. For these media, the current Army preference of flaming (burning) the contaminated media (to achieve XXXXX level of decontamination as defined in Army Regulation AMCCOMR-385-5) was considered an ARAR from an explosives deflagration/detonation safety standpoint, rather than an environmental standpoint.

**Table 2-1**
**Preliminary Remediation Goals for the Explosives Washout Plant (Building 489) Interior Building Surfaces**

**Accessible Surfaces (below 6 feet)**

| Analyte | Carcinogenic PRG (1E-05 Risk Level) (mg/m2) | Carcinogenic PRG (1E-05 Risk Level) (μg/cm2) | Noncarcinogenic PRG (Hazard Index of 1) (mg/m2) | Noncarcinogenic PRG (Hazard Index of 1) (μg/cm2) |
|---|---|---|---|---|
| 135TNB | * | * | 4.63 | 0.46 |
| 246TNT | 128 | 12.8 | 46.3 | 4.63 |
| HMX | * | * | 4632 | 463 |
| RDX | 35 | 3.5 | 278 | 27.8 |

**Inaccessible Surfaces (above 6 feet)**

| Analyte | Carcinogenic PRG (1E-05 Risk Level) (mg/m2) | Carcinogenic PRG (1E-05 Risk Level) (μg/cm2) | Noncarcinogenic PRG (Hazard Index of 1) (mg/m2) | Noncarcinogenic PRG (Hazard Index of 1) (μg/cm2) |
|---|---|---|---|---|
| 135TNB | * | * | 9.26 | 0.92 |
| 246TNT | 256 | 25.6 | 92.6 | 9.26 |
| HMX | * | * | 9264 | 926 |
| RDX | 70 | 7 | 556 | 55.6 |

*Not calculated because contaminant is not considered a carcinogen or slope factor is not available.

Source: Dames & Moore[13]

### 2.2.1 Applicable or Relevant and Appropriate Requirements (ARARs)

The selection of ARARs is dependent on the hazardous substances present at the site, the site characteristics and location, and the actions selected for a remedy; therefore ARARs are developed in three categories:

- Chemical-specific;
- Location-specific; and
- Action-specific.

Chemical-specific ARARs are health- or risk-based concentration limits set for specific hazardous substances, pollutants, or contaminants. Location-specific ARARs address such circumstances as the presence of wetlands on the site or the location of 100-year floodplain. Action-specific ARARs control or restrict particular types of remedial actions as alternatives for cleanup.

***2.2.1.1 Chemical-Specific ARARs.*** In developing chemical-specific ARARs, both state and federal regulations were considered; however, neither state nor federal regulations presented requirements for remediating buildings, structures, or process equipment for explosive contamination.

*Oregon Soil Cleanup Standards* - Soil cleanup standards for individual chemical contaminants have recently been promulgated under State of Oregon laws. In June 1992, the state formally promulgated new soil cleanup standards for 77 hazardous substances. The regulation provides standards for cleanups under both residential and industrial use scenarios, based on a residual excess cancer risk of $10^6$. However, the rule does not include any of the four contaminants of concern.

The Oregon Environmental Cleanup Law does provide a process for determining contaminant cleanup levels on a site-specific basis. Oregon Department of Environmental Quality (DEQ) has indicated that it should be considered an ARAR at UMDA. The process is as follows:

- In the event of a release of a hazardous substance, the environment shall be restored to background level (i.e., the concentration naturally occurring prior to any release from the facility) [OAR 340-122-040(2)(a)] where feasible.

- When attaining background is not feasible, the acceptable cleanup level in the soil shall be the lowest concentration level that satisfies both the "protection" and "feasibility" requirements in OAR 340-122-090(1). The party responsible for the contaminated site is responsible for demonstrating the non-feasibility of attaining background.

The Oregon soil cleanup standards are not applicable to the washout water sump or Washout Plant themselves, but are applicable to the soil under the sump, and to the soil under and around the Washout Plant. This soil under the sump and washout water trough and around the Washout Plant is being addressed under the Washout Lagoon soil remediation project.

*RCRA Treatment Standards* - Two RCRA waste listings, K044 and K047, specifically apply to explosives wastes:

- K044 applies to wastewater treatment sludges generated during the original manufacture and loading, assembling, and packing of reactive explosives; and

- K047 applies to wastes generated during the production and formulation of TNT and TNT-containing products.

RCRA requires that any of the wastes that are considered a K047 or K044 waste be treated prior to land disposal to remove the hazardous characteristic (reactivity) of the waste (40 CFR 268.42). For these two wastes the treatment method would be deactivation (40 CFR 268.42, Table 1), and the technologies include:

| RCRA Code | Non-wastewater | Wastewater |
|---|---|---|
| K044 | Chemical Oxidation<br>Chemical Reduction<br>Incineration | Chemical Oxidation<br>Chemical Reduction<br>Biological Degradation<br>Carbon Adsorption<br>Incineration |
| K047 | Chemical Oxidation<br>Chemical Reduction<br>Incineration | Chemical Oxidation<br>Chemical Reduction<br>Biological Degradation<br>Carbon Adsorption<br>Incineration |

RCRA, however, states that use of these technologies is not mandatory and does not preclude the use of other technologies provided deactivation is achieved and the alternate methods are not performed in land disposal units. The operations at the Explosives Washout Plant did not involve the manufacturing, loading, assembly, or packing of explosives, nor the production and formulation of TNT compounds. Therefore, the wastes formerly generated at the Washout Plant do not strictly meet the definition of listed wastes and the RCRA requirements and, therefore, not legally applicable.[5] Furthermore, the K044 and K047 wastes are listed by RCRA solely for the characteristic of reactivity and not for specific chemical constituents. For explosives, the following two definitions apply:

- It is capable of detonation or explosive reaction if it is subjected to a strong initiating source or if heated under confinement. [40 CFR 261.23(a)(6)]

- It is readily capable of detonation or explosive decomposition or reaction at standard temperature and pressure. [40 CFR 261.23(a)(7)]

Since the K044 and K047 wastes were listed because of the characteristic of reactivity, the RCRA reactivity criteria is only appropriate to three of the waste materials that might be generated during remediation. These are:

- The sludge in the washout water sump
- Any spent solvent generated by solvent rinsing the process equipment
- Solvent wet cloths used for solvent wiping building and equipment surfaces

The washout water sump sludge, spent solvent and solvent wet cloths would be disposed of by burning or incineration to comply with the regulations for disposal of reactive wastes.

Disposal of building materials or equipment generated during remediation of the Washout Plant contaminated with explosives of less than reactive quantities will be governed by health or risk concentration limits set by the PRGs, since the above regulations regarding K044 and K047 wastes and reactivity are not applicable or appropriate, but may be classified as To be Considered (TBC) guidance.

For hazardous debris (which includes contaminated piping, pumps, values, and industrial equipment), the Land Disposal Restrictions (LDRs) variance has been extended from May 8, 1993, to May 8, 1994, with some additional conditions (Federal Register, May 14, 1993, Vol. 58 No. 92, pp. 28506–511). The variance will be granted on a case-by-case basis *if* the generator has demonstrated a "good faith effort" to try to find a treatment facility that has capacity within the 90-day storage limit or 30-day extension. This "good faith effort" requires that at least ten treatment facilities that have treated similar wastes in the past be contacted. According to Chemical Waste Management Inc. (Ms. Joyce Johnson), these regulations would apply to the process equipment contaminated with explosive wastes. The hazard in this case would be process equipment or debris with residual explosive above the PRG concentration, but below the level necessary for exhibiting reactivity.

*AMCCOM (Armament, Munitions, and Chemical Command) Regulation No. 385-5: Decontamination and Disposal of Facilities, Equipment and Material* - AMCCOM Regulation No. 385-5 prescribes policies, responsibilities, and procedures relating to decontamination and disposal of contaminated items (facilities, land, tooling, material, and equipment) that have been or may have been contaminated with energetic materials. The regulation further describes four degrees of decontamination, including (AMCCOMR 385-5 4 e):

- X - A single "X" indicates item has been partially decontaminated by routine cleaning. Maintenance is limited to preventive maintenance and minor adjustments. Further decontamination is required for replacements, major repairs, or moving the item or components to another location.
- XXX - Three "Xs" indicate that an item has been examined and cleaned by approved procedures and visible contamination does not exist as determined by appropriate instrumentation, test solutions, or by visual inspection on easily accessible surfaces or in concealed housing, etc. and is considered safe for the intended use. Items decontaminated to this degree cannot be furnished to qualified DoD or industry users or be subjected directly to open flame (cutting, welding, high temperature heating devices), or operations that generate extreme heat.
- XXXXX - Five "Xs" indicate that the equipment or facilities have been completely decontaminated, are free of hazard and may be released for general use or to the general public.
- 0 - A "0" (Zero) indicates the item, although located in a contaminated area, was never directly exposed to contamination.

In the present regulations there is little difficulty understanding the acceptable procedures for achieving X or XXX levels of decontamination. For XXX the procedures include flushing, washing, boiling, and neutralization of major items of equipment and facilities and decontamination or disposal of smaller items by "flashing" (burning). For XXXXX decontamination, however, the procedures are not as well defined. The regulation allows for decontamination of explosives to XXXXX degree by flashing or by other means that when accompanied by adequate sampling to show that the item is completely decontaminated, but there is a strong inference (supported by the DoD Explosive Board and AMCCOM) that thermal treatment is the only method certain to totally decontaminate explosive contaminated items so that they can be released for general use or to the general public.

AMCCOMR 385-5 states that "the primary method of assuring complete decontamination [XXXXX] of energetic materials is to subject the item/items involved to a temperature which is high enough to assure autoignition of the contaminant." Several of the active Army Ammunition Plants (AAPs) that manufacture explosives similar to the contaminants at UMDA use thermal methods for decontaminating explosive contaminated items prior to their release. Radford AAP has a Standard Operating Procedure (SOP) for XXXXX that requires that the temperature of the item be brought to 600 °F for 4 continuous hours. The Holston AAP SOP requires that the temperature of the item be brought to 600 °F for a minimum of 3 continuous hours.

As was the case for the above decontamination procedures (and facilities), decontamination procedures must be developed as General Operating Procedures (AMCCOMR-385-5) and Standing Operating Procedures (Decontamination of Facilities and Equipment, TB 700-4) for each specific decontamination operation and each specific activity. Technical assistance in the development of the Standing Operating Procedures (SOPs) may be obtained from DARCOM, the Department of the Army Readiness Command (TB 700-4). The SOP for each procedure and installation or activity must be approved by the installation safety officer, commanding officer, and Commander, U.S. Army Armament Munitions and Chemical Command (AMCCOMR-385-5).

In most cases, decontamination of materials to the XXXXX level (for release to a DRMO or the public) has involved thermal processes, but in a limited number of cases, where all the contamination is on the surface and all surfaces are accessible, wipe testing has been used instead to ensure the absence of explosive. (Some materials disposed of in the active landfill at UMDA are wipe tested with Webster's Reagent to verify the absence of TNT prior to disposal.) Preliminary tests at Arthur D. Little indicate the detection limit for TNT (and, probably, TNB) by Webster's Reagent is in the order of 1 to 10 μg/sq cm.

In summary, the AMCCOMR 385-5 requires that any equipment or facilities that are to be released to the general public or for general use must be completely decontaminated and free of hazard (XXXXX). While there is some uncertainty as to what procedures should be followed to meet this requirement, the primary and preferred method of decontamination is thermal treatment.

*Risk-based ARAR* - An amendment to the Human Health Baseline Risk Assessment has been recently prepared and is included as Appendix B to this FS[3]. This baseline risk assessment includes the excess risks associated with the carcinogenic explosives (TNT and RDX) and non-carcinogenic explosives (TNB and HMX) found in the Washout Plant as well as preliminary remediation goals (PRGs) for cleanup of the Washout Plant. The PRGs proposed for the Washout Plant are summarized in Table 2-1.

Because of the conservative nature of the risk-based cleanup levels, it is important to note that they are target levels that do not consider potential technology limitations. A detailed analysis of the selected remedial alternatives ability to meet the risk based cleanup levels is presented in Section 4.0, Detailed Analysis of Alternatives.

***2.2.1.2 Location-Specific ARARs***. Location-specific ARARs set restrictions on remedial action activities depending upon the characteristics of a site and/or its immediate environs. These ARARs are contained in a number of federal statutes and regulations. In addition, the state of Oregon has requirements that may apply in a given situation. The information regarding the characteristics of UMDA was obtained from the Final RI Report.[2] Table 2-2 lists the regulations that may be considered ARARs for UMDA.

In addition to the ARARs discussed in each of the following sections, consideration should also be given to the local planning requisites in both Morrow and Umatilla Counties. Oregon law mandates that each county and community develop, and have approved by the state, a comprehensive land use plan that must take into consideration many of the same concerns addressed in this discussion. Local land use is an appropriate consideration because remedial actions may be affected by adjacent activities, and also the possibility of future land use changes because of UMDA's inclusion in the Base Realignment and Closure Program. Consultation with the appropriate county officials and cognizance of their land use plans and goals would no doubt increase the efficacy of any actions proposed or taken at UMDA.

*Caves, Salt-dome Formations, Salt-bed Formations, Underground Mines*. The bedrock under UMDA and the surrounding area consists of basalt laid down by lava flows during the Miocene Period. This is capped by a mixture of Pleistocene alluvial deposits, including clays, sands, silts, gravels, and some boulders. There are sedimentary interbeds between the lava flows and this type of rock also has tunnels and occasionally "lava holes." However, there are no indications of caves, salt-dome formations, salt bed formations or underground mines on the site, nor would such features normally be expected with a structural bedrock of basaltic lava flows. Thus no ARARs were developed in this category.

**Faults.** UMDA is surrounded by four structural features: the Service Anticline on the east, an anticline on the west, the Dalles-Umatilla Syncline to the north, and a monocline to the south. This Service Anticline runs north to south and is faulted on both its east and west limbs. There are active Holocene faults approximately 50 to 80 miles north of the site, near the Hanford Nuclear Reservation in Washington. There is also a suspected active Holocene fault approximately 70 miles southeast of the depot near LeGrand, Oregon. However, none of the faulting associated with the Service Anticline is documented or believed to have been displaced during the Holocene period, nor is it considered active.

**Table 2-2: Selected Location-Specific Applicable or Relevant and Appropriate Requirements (ARARs) (page 1 of 3)**

| Location | Requirement | Prerequisite(s) | Citation |
|---|---|---|---|
| Wetland | Must take action to avoid adverse impact, minimize potential harm, and to preserve and enhance wetlands to the extent possible. | Wetlands as defined 40 CFR 6, Appendix A §4; action of federal agencies involving construction of facilities or management of property in wetland areas. | Executive Order 11990; Protection of Wetlands (40 CFR 6 Appendix A); 40 CFR 6.302(a) |
| | Federal agencies shall incorporate floodplain management goals and wetlands protection considerations in their planning, regulatory, and decision-making process. | | 40 CFR 6, Appendix A |
| | Federal agencies should avoid new construction in wetlands areas. | | 40 CFR 6, Appendix A |
| | Prohibits discharge of dredge or fill material into wetlands without permit. | Wetlands as defined in U.S. Army Corps of Engineers and EPA regulations. | Clean Water Act §404; 40 CFR 230.10; 33 CFR 320-330; ORS 196-.105 et seq; OAR §141-85-005 et seq. |
| | Provides for the enhancement, restoration, or creation of alternate wetlands. | Unavoidable adverse impacts on wetlands. | Clean Water Act §404(b)(1) |

**Table 2-2: Selected Location-Specific Applicable or Relevant and Appropriate Requirements (ARARs) (page 2 of 3)**

| Location | Requirements | Prerequisite(s) | Citation |
|---|---|---|---|
| Critical habitat upon which an endangered or threatened species depends | Must take action to conserve endangered or threatened species; must not destroy or adversely modify critical habitat.<br><br>Must consult with Department of Interior, FWS, and state personnel required to ascertain that proposed actions will not affect any listed species. | Determination of presence of federal or Oregon listed endangered or threatened species. | Endangered Species Act of 1973 (16 USC 1531 et seq.); 50 CFR 402; Fish and Wildlife Coordination Act (16 USC 661 et seq.); ORS 496.004; ORS 496.172 et seq.; ORS 498.026; ORS 498.04 |
| Within area where action may cause irreparable harm, loss, or destruction of significant artifacts | Must take action to recover and preserve artifacts. | Dam construction or alteration of terrain that threatens significant scientific, prehistorical, historical, or archeological data. | Archaeological and Historic Preservation Act (16 USC 469a-1) |

**Table 2-2: Selected Location-Specific Applicable or Relevant and Appropriate Requirements (ARARs) (page 3 of 3)**

| Location | Requirements | Prerequisite(s) | Citation |
|---|---|---|---|
| Historic project owned or controlled by federal agency | Must take action to preserve historic properties; planning of action to minimize harm to National Historic Landmarks. | Federal agencies must get approval for actions that affect property included in, or eligible for, the National Register of Historic Places. | National Historic Preservation Act (16 USC 470 et seq.); 36 CFR 800.1; National historic Landmarks Program (36 CFR 65); National Register of Historic Places (36 CFR 60) |
| | Federal Agencies must identify possible effects of proposed remedial activities on historic properties, and measures implemented to minimize or mitigate potential effects. | | Executive Order 11593: 36 CFR 800.4 |
| Archaeological sites or resources on public land. | Must take steps to protect resources and to preserve data. | Archaeological resources and sites as defined in 16 USC 470aa-II. | Archaeological Resources Protection Act of 1979 (16 USC 470 aa-11; 42 CFR 7) |

Source: Oak Ridge National Laboratory[7]

Because of the surrounding area's history of low seismicity, UMDA is exempted from compliance with the RCRA seismic requirements of 40 C.F.R. § 264.18 since CFR§ 264.18(a) stipulates that all facilities that are located within political jurisdictions other than those listed in Appendix VI are assumed to be in compliance for location of new treatment, storage, or disposal (TSD) facilities. Oregon is not listed in Appendix VI.

*Wilderness Areas, Wildlife Refugees, and Scenic River.* There are no designated wilderness areas within UMDA, or in its immediate vicinity. Neither the Columbia River nor the Umatilla River, both of which lie within 3 miles of the depot, have been designated as scenic rivers. There are, however, three wildlife refuges in very close proximity to the depot; Cold Spring National Wildlife Refuge at 15 miles, Umatilla National Wildlife Refuge at 8 miles, and Irrigon State Wildlife Refuge at 2 miles. The latter of these refuges, Irrigon, is protected under state law and is considered a sensitive environment. It is one of the primary wetlands in this region and supports a major waterfowl wintering habitat.

There would be no ARARs for on-site actions because the UMDA itself is not located within a refuge. However, the proximity of Irrigon State Wildlife Refuge (2 miles) and its potential hydrological connection to UMDA cautions careful analysis of any actions that might impact that system.

*Wetland and Floodplains.* The Columbia River is now largely dam controlled, thus eliminating most concerns with flooding hazards. Information available indicates that UMDA is not located within 100- or 500-year floodplains and therefore no ARARs were developed in this category.

There are a number of wetlands in the immediate area of UMDA, to the east, west, and south. Those associated with the Umatilla River on the east come within at least 1 mile of UMDA. Additionally, the wetlands located near the northwest corner of the depot extend to the boundary of the UMDA. Wetlands located to the west of UMDA are associated with Irrigon State Wildlife Refuge and those to the south are 2.5 to 3.5 miles from the depot.

Since none of the identified wetlands are within the UMDA boundary, there would be no ARARs for on-site actions per se. However, any actions that would affect the wetlands adjacent to UMDA ("off-site") would be subject to a number of state and federal ARARs.

*Rare, Threatened, or Endangered Species.* The UMDA installation is part of the critical winter range of both the bald eagle (Haliaeetus leucocephalus) and the golden eagle (Aquila chrystaetos). The former is on the federal endangered and threatened species list and both are protected under the Fish and Wildlife Coordination Act. The peregrine falcon (*Falco peregrinus*), another federally endangered species, has been sighted in the vicinity of UMDA, and the installation is considered part of its critical habitat. One of three small habitats along the Columbia River where the long-billed curlew(*Numenius Americanus*) still breeds is located on the installation. The species is on the federal "Candidate" list. Curlews at UMDA have been noted nesting in open grassy areas. The Washout Plant area has not been noted as a preferable nesting site for curlews. Because of this and the small size of the site compared to the large amounts of open undisturbed grassland available at UMDA, remedial actions at the Washout Plant are not expected to have a significant adverse impact on curlew nesting. Although no eagles, falcons, or curlews have been observed in the vicinity of the Washout Plant, any plans for

remediation activity will have to be reviewed by the EPA and Fish and Wildlife Service. No federal or state threatened or endangered plants have been identified at UMDA.

Any action that would affect any endangered or threatened species, or adversely impact a species' critical habitat, would be subject to the ARARs outlined in Table 2-2. There are no additional state threatened or endangered species known to inhabit UMDA (ORNL, 1991).[7]

*Artifacts and Historical and Archeological Sites.* There are two known historic buildings at UMDA, the headquarters building and the firehouse building. There are also two potential archeological resources at UMDA that have been tentatively identified as a portion of the Oregon Trail and a prehistoric site. None of the activities at the Explosives Washout Plant will affect these locations, so ARARs are not triggered.

***2.2.1.3 Action-Specific ARARs.*** Action-specific ARARs are usually technology- or activity-based requirements or limitations on actions taken with respect to hazardous wastes. These requirements are triggered by the particular remedial activities that are selected to accomplish a remedy. On-site CERCLA response actions must only comply with the substantive requirements of regulations, and not the administrative requirements [CERCLA §121(e)]. Therefore, in the event that the remedial alternatives for the Explosive Washout Plant are considered to take place within the confines of the CERCLA unit, none of the permitting requirements of RCRA, the Clean Air Act, etc., are considered as ARARs.

The RCRA land disposal restrictions (LDRs) list the treatment standard for D003, K044, and K047 wastes simply as "deactivation" [40 CFR 268.42 (Table 2)]. The recommended treatment technologies for deactivation are incineration, chemical oxidation, or chemical reduction [40 CFR 268 (Appendix VI)]. However, it is stated that use of these technologies is not mandatory and does not preclude the use of other technologies provided deactivation is achieved and the alternate methods are not performed in land disposal units. LDRs do not apply to movement of waste within a unit (55 FR 8759), and thus would not be ARARs for actions taken within the Washout Plant. In the event that the contaminated building materials or process equipment are considered to be removed from the unit for treatment, the LDRs may apply. However, EPA has determined that the LDRs are generally inappropriate or non-achievable for soil and debris from a CERCLA response action, and recommend a treatability variance for such materials (55 FR 8760).

The Oregon Hazardous Waste management regulations appear in the OAR, Chapter 340, Divisions 100-120. These regulations have been amended over the years to reflect the federal RCRA regulations, and adopt them by reference in almost all instances. Therefore, the Oregon regulations are not repeated here.

At closure, all hazardous waste and hazardous waste residues must be removed from the site (e.g., ash, scrubber waters, and scrubber sludges) in accordance with RCRA generator requirements found in 40 CFR 262 through 266. The incinerator, if used in Alternative 5B for concrete rubble incineration, and all ancillary equipment must be decontaminated prior to removal.

## 2.3 General Response Actions

This section describes broad categories of remedial measures, called general response actions, that could be used to achieve the remedial action objectives described in Section 2.2. A particular general response action might be able to be accomplished by any of several technology types. In turn, a single technology type might encompass several more specific methodologies, called process options. For example, "treatment" would be a general response action, "thermal treatment" would be a technology type, and hot gas decontamination or flaming would be two examples of process options.

The following combinations of general response actions have been considered potentially applicable for the remediation of the Washout Plant:

- No Action
- Institutional Control
- Demolition/Disposal
- Treatment/Demolition/Disposal
- Treatment/Disposal

The National Contingency Plan (NCP) requires that "No Action" be included among the general response actions evaluated in every FS [40 CFR 300.430(e)(6)]. No Action means that no response to contamination is made, activities previously initiated are abandoned, and no further active human intervention occurs. However, natural attenuation of the contaminated media will likely occur over time through dilution, biological degradation, and abiotic degradation. The No Action response provides a baseline for comparison to the other remedial response actions.

*Institutional Controls* include measures such as land use restrictions (achieved through zoning and legal restrictions), site access restrictions, and relocation of receptors. Although potential exposure can be reduced by these means, the contaminated media are not directly remediated. As with No Action, natural attenuation of the contaminated media will likely occur with time.

*Demolition/Disposal* alternatives remove the contaminated media from the site and dispose of it in a more secure situation. However, while these alternatives remove the contaminated media from the site, and therefore remove the contamination from the on-site receptors, they do not reduce the toxicity or volume of the contamination. In fact, demolition might temporarily increase exposure by increasing the mobility of the contaminants. As with No Action, natural attenuation of the contaminated media will likely occur with time.

*Treatment/Demolition/Disposal* alternatives permanently and significantly reduce the toxicity, mobility, or volume of the waste. In these alternatives several technologies may make up the remediation of the Washout Plant or may include pretreatment technologies to prepare the wastes for final treatment. Although treatment technologies can change the nature of the wastes or contaminated materials, there will be residual materials or byproducts that will have to be disposed of with or without further treatment. The residuals may or may not be hazardous.

*Treatment/Disposal* alternatives significantly reduce the toxicity, mobility, or volume of the waste. In these alternatives the building structure and process equipment would be decontaminated and the process equipment disposed of, but the building (or structure)

would be retained for future use. Soil under the building, however, could be contaminated from operations prior to the construction of the current building. The contaminated media under the building are not directly remediated. As with No Action, natural attenuation of the contaminated media may occur with time.

### 2.3.1 Estimated Quantity of Contaminated Materials Requiring Remediation

The total quantity of building materials and equipment potentially requiring remediation is presented in Table 2-3. This includes all of the structural material from Building 489, the equipment currently inside Building 489, and the steel overflow trough, concrete sump, and sump contents. It was assumed that prior to the remediation of the sump itself, the explosives-contaminated water and sludge from the sump would be removed and treated separately by UMDA personnel, or subcontractor, as part of the pretreatment operations. The sludge would be burned in the TNT burn pits where this same sludge has been burned in the past, or in burn pans in the ADA (which are permitted to the end of 1994). The washout water would be added as moisture makeup to the washout lagoon soil compost piles where the explosive contaminants in the water would be biologically decomposed along with the explosive contaminants in the soil. The volume of sludge and water currently in the sump is not known. Table 2-4 provides a list of the process equipment in the building and its estimated quantity.

## 2.4 Identification and Screening of Technology Types and Process Options

In this section, the technologies associated with the general response actions discussed in Section 2.3 and typical process options for each technology are identified, and the results of the technology screening evaluation are presented. The screening was intended to eliminate inappropriate remedial options. The rationale for rejecting certain process options or whole technologies is presented here. Process options selected for further detailed evaluation are described in Section 2.4.2, Evaluation and Selection of Representative Technologies.

A two-step screening process was used. The preliminary screening reviewed technical and regulatory implementability to eliminate clearly inappropriate options. Those candidate technologies that are found to be potentially applicable in the preliminary screening are carried to the second screening. The second screening reviewed the remaining process options in greater detail for three criteria:

- Effectiveness
- Implementability
- Cost

As stipulated by EPA, the cost criterion played a limited role in the screening of technologies and process options. Greater emphasis was placed on effectiveness and implementability, so that clearly effective and implementable remedial technologies were retained for further detailed analysis. Only relative capital and operating and maintenance costs were considered, with evaluations made on the basis of engineering judgment. The detailed analysis develops remedial costs in greater depth so as to provide guidance for the effective development of a Record of Decision (ROD).

**Table 2-3: Estimated Quantity of Explosive Contaminated Materials in Washout Plant**

| | Surface Area (Sq Ft) | Volume (Cu Ft) |
|---|---|---|
| Concrete (Including Explosive Washout Water Sump) | 8,500 | 5,800 |
| Galvanized Steel Siding** | 1,000* | 240 |
| Aluminum Siding and Roof Panels** | 2,300 | 380 |
| Asbestos Insulation** | 300 | 150* |
| Electric Wiring and Controls (Inside Building)** | 400 | 60 |
| Process Equipment | 3,200 (exterior surfaces) | 3,350 |
| Ladders and Walkways** | 200 | 100 |
| Steel Explosive Washout Water Trough** (Between Building 489 and Washout Lagoons) | 600 | 200 |
| **Approximate Total** | **16,500 sq ft** | **10,480 cu ft** |

* Estimated contaminated portion of 8,300 sq ft total of corrugated galvanized steel siding and roofing and contaminated portion of 300 cu ft total of asbestos insulation on piping and equipment.

** Decontaminated, if necessary, during pretreatment operations.

Sample calculations for estimates of total concrete surface and volume are included in Appendix A.

Source: Arthur D. Little, Inc.

**Table 2-4: Estimated Quantity of Potentially Explosive-Contaminated Process Equipment in Washout Plant**

| Process Equipment | External Surface Area (sq ft) | Estimated Volume (cu ft) |
|---|---|---|
| Washout Tanks 51 ft x 6 ft x 5.5 ft ht (Total size 3 tanks) | 1610* | 1,630 |
| Washout Tanks Vent to Roof 3.5 ft diam. x 35 ft | 440 | 440 |
| Heat Exchangers and Pumps 30 ft x 2 ft x 2 ft | 200 | 120 |
| Piping 1000 ft x 2 in (2.5 in O.D.) | 210 | 150 |
| Separation Tank 6 ft ht x 7 ft diam. | 130 | 300 |
| DOPP Kettle 2 ft ht x 7 ft diam. | 50 | 100 |
| Pellet Tower 7 ft ht x 3.5 ft diam. | 80 | 90 |
| Pelletizer Pumps 4 at 8 cu ft each | 30 | 32 |
| Dryer 15 ft x 7 f. x 4 ft | 390 | 420 |
| Overhead Hoist | 60 | 40 |
| **Approximate Total** | **3,200 sq ft** | **3,350 cu ft (130 cu. yds.)** |

*External surface plus accessible internal surface.
Sample calculations for washout tank surfaces and volumes are included in Appendix A.

Source: Arthur D. Little, Inc.

### 2.4.1 Identification and Screening of Technologies

Figure 2-1 shows the general response actions presented in Section 2.3 as well as possible technologies and process options. The technologies and process options shown were, in part, selected on the basis of previous Arthur D. Little experience in remediating contaminated buildings. The results of the preliminary screening are shown in the figure by shading those technologies and process options that are not applicable to the cleanup of the Washout Plant. Comments summarizing the reason for their further consideration or elimination are provided in the far right column.

Technologies and process options were initially screened by assessing whether or not they were conceptually viable with respect to technical capabilities and regulatory preferences. A brief discussion of the important parameters and rationale behind particular screening decisions, by remedial technology, follows.

**No Action.** The No Action alternative does not reduce human exposure or contaminant toxicity, mobility, or volume. However, as required by the NCP, it will be carried through subsequent screening and analysis as a baseline reference point for review and comparison of various technologies.

**Institutional Controls.** Access restrictions are methods of minimizing or preventing human exposure to contaminants, but they do not reduce the toxicity, mobility, or volume of contaminants. The UMDA is scheduled for realignment under the BRAC program; a date for closure has not been determined, at this time, due to the ongoing chemical stockpile demilitarization mission. Following completion of that mission, the possibility exists that the site could be closed. At that time, ownership and use of the land could be transferred to another agency or to private interests. Although specific future development plans for the site have not been prepared, both EPA and the State of Oregon have indicated a strong preference for maintaining the flexibility to use the land for residential or light industrial purposes. Legal and zoning restrictions, fences, warning signs, and similar controls to limit use of the site would be required along with partial remediation (disposal of washout water sump solids and water) for implementation of this alternative.

**Remediation Treatment (Physical Treatment).** Physical treatment typically involves the transfer of contaminants from one medium to another, with or without concentration, for the purpose of facilitating final treatment or disposal. Of the 13 technologies reviewed in this category only three were found to be potentially applicable:

- Hydroblasting
- Cold Solvent Washing
- Solvent Wiping

Even though these process option were retained, none of them alone would be applicable to all the media in the Washout Plant, and they would have to be combined with other options to form a viable alternative.

The process options that were not selected were eliminated for several reasons. The major reasons for elimination were: the inability of the technology to remediate the contaminants of concern or their ineffectiveness on the media; and the potential environmental or safety hazard posed by the technology.

## Figure 2-1: Preliminary Screening of Remedial Technologies and Process Options (Page 1 of 3)

| General Response Action | Remedial Technology | Process Option | Description | Screening Comments |
|---|---|---|---|---|
| No Action | None | Not Applicable | No Action | Required for consideration by NCP |
| Institutional Controls | Access Restriction | Secure & Maintain Bldg. Legal Restrictions | Fence in Washout Plant; maintain building, add legal restrictions | Potentially applicable in conjunction with partial remediation. |
| Remediation Treatment | Physical Treatment | Absorption | Use of absorbent material for surface liquid contaminants | There are no liquid surface contaminants. |
| | | Dusting, Vacuuming, and Wiping | Removal of loose, dry, surface contamination by wiping, dusting, or vacuuming | Potentially applicable for pretreatment. |
| | | Encapsulation | Painting or sealing structural surfaces | Not an option for the building structure because of potential future base closure. |
| | | Grit Blasting | Surface removal (0.5-1.5 cm) by abrasive in a high velocity air stream | Although potentially applicable for contaminants, there is potential for dust explosion. |
| | | Hydroblasting/ Waterwashing | Surface removal (0.5-1.5 cm) by high-pressure water jet containing additives and/or abrasives | Potentially applicable for all surface and near surface contamination. Has been used for explosive decontamination. |
| | | Scarification | Physical hammering to break up masonry surface | Can only be used on concrete surfaces. There is potential for explosive detonation. |
| | | Drilling and Spalling | Holes are drilled in concrete and expansion tool inserted in drill hole breaks off pieces of concrete | Only applicable to concrete portion of structure. Large volume of hazardous waste generated. |
| | | K-20 Sealant | Commercial sealant material that coats and penetrates porous surface to seal internal contamination | The effectiveness of this material for sealing explosives has not been demonstrated. |

☐ Potentially applicable technology

▨ Eliminated from further consideration

## Figure 2-1: Preliminary Screening of Remedial Technologies and Process Options (continued) (Page 2 of 3)

| General Response Action | Remedial Technology | Process Option | Description | Screening Comments |
|---|---|---|---|---|
| Remediation Treatment | Physical Treatment (continued) | Cold Solvent Washing | Washing of building structure or equipment with liquid solvent to remove contaminants | Health, fire, and explosion hazard if flammable solvent applied to structure, but potentially applicable for internal cleaning of heavily contaminated process equipment. |
| | | Radkleen Solvent Washing | Washing of building structure or equipment with a chlorofluorocarbon | There is an upcoming ban (in 1995) on the production of chlorofluorocarbons, and there is a potential emission problem. |
| | | Solvent Wiping | Wiping of non-porous contaminated surfaces with solvent wet cloth | Potentially applicable for non-porous surfaces. |
| | | Vapor Phase Solvent Extraction | Use of condensing solvent vapors to dissolve and rinse contaminants from surface | Potentially serious health, fire, and explosion hazards if applied to building structure. |
| | | Acid Etching | Use of acid to attack material surface with subsequent rinsing of surfaces | Very hazardous procedure to personnel. Not effective on concrete surfaces and generates (explosive) hydrogen gas if used on galvanized steel or aluminum sheeting. |
| | Chemical Treatment | Bleaching | Application of bleach to contaminated surfaces followed by rinsing | Not effective for treating explosives. |
| | | Microbial Degradation | Microbes are applied to surfaces to be decontaminated | Applicable to soil treatment, but not applicable to building structure or equipment because of need to maintain necessary biological environment (temperature, moisture, nutrients) at building or equipment surfaces. |
| | | Photochemical Degradation | Use of ultraviolet light to break down contaminants | Not a proven technology for explosives. Treats surface contamination only. |

☐ Potentially applicable technology

▒ Eliminated from further consideration

## Figure 2-1: Preliminary Screening of Remedial Technologies and Process Options (continued) (Page 3 of 3)

| General Response Action | Remedial Technology | Process Option | Description | Screening Comments |
|---|---|---|---|---|
| Remediation Treatment | Thermal Treatment | Steam Cleaning | Use of steam (with or without solvent additive) for cleaning surfaces | Steam cleaning has already been used to clean this building and equipment, but residual explosive is suspected to remain inside the process equipment. |
| | | Flaming | Use of open flame to vaporize and decompose explosives | Demonstrated technology for building and equipment surfaces. High temperature more destructive to materials than similar Hot Gas Decontamination. Potentially applicable for sump and for equipment surfaces if equipment is cut open. |
| | | Hot Gas Decontamination | Use of hot gas to vaporize explosive followed by incineration of hot gas and vapor | Demonstrated technology for explosive contaminated buildings and equipment. |
| | | Incineration | Use of rotary kiln for incineration of building materials (concrete rubble). | Demonstrated technology for materials that can be fed to kiln. Only applicable here for broken concrete. |
| Dismantling | Dismantling | Equipment Disassembly | Partial disassembly of piping and equipment | Potentially applicable in conjunction with other process options to insure safety and efficient decontamination. |
| Demolition | Demolition | Building Demolition | Disassembly of roof and metal siding and demolition of concrete slabs | Potentially applicable in conjunction with other process options. |
| Disposal | Disposal | Onsite Disposal of Decontaminated Rubble or Equipment | Landfill decontaminated rubble onsite; sell scrap metal | Potentially applicable. |
| | | Onsite Disposal of Contaminated Rubble or Equipment | Landfill of contaminated materials in on-site landfill | Potentially applicable. |
| | | Offsite Disposal of Contaminated Rubble or Equipment | Treatment and/or landfill of contaminated materials in secure off-site landfill | Potentially applicable. |

☐ Potentially applicable technology

▒ Eliminated from further consideration

Source: Arthur D. Little, Inc.

*Absorption* – Absorbent materials are used to pick up liquid contaminants. As soon as possible following the contaminant spill, the absorbent material is applied to the liquid puddle(s). Application can be by hand, shovel, dump truck, or other mechanical or manual means. After time has been allotted for the absorbents to soak up the contaminated liquid, the contaminated absorbent is removed by shovel or other means and placed in containers for delivery to a disposal site. Depending on the surface and time elapsed since the spill, secondary decontamination may be required to clean up surface residues and subsurface contamination. The contamination at the Washout Plant is not liquid, therefore this technology was eliminated.

*Dusting/Vacuuming and Wiping* – This method is simply the physical removal of hazardous dust and particles from building and equipment surfaces by common cleaning techniques. Vacuuming is performed using a commercial or industrial vacuum equipped with a high-efficiency particulate air (HEPA) filter. Dusting is performed with a damp cloth to remove dust from surfaces not practically treatable with a vacuum. In the Washout Plant, with few exceptions (e.g., the tops of ceiling beams), all loose explosive contamination has already been removed by steam/hot water cleaning and therefore dusting/vacuuming is not applicable for remediation of the explosive contamination, but could be applicable for removal of the pigeon droppings during pretreatment.

*Encapsulation* - Contaminants or contaminated structures are physically separated from the ambient environment by a barrier. An encapsulating or enclosing physical barrier may take different forms; among them are plaster, epoxy resins, and concrete casts and walls. These barriers act as an impenetrable shield, to keep contaminants inside and away from clean areas, thereby alleviating the hazard. Also included would be the use of paints or coatings to fix or stabilize the contamination in place. This is not a preferred option because UMDA could be a candidate for future base closure and the building will likely have to be demolished and the containment would not be effective after demolition.

*Gritblasting* – Gritblasting is a surface removal technique in which an abrasive material is used for uniform removal of contaminated surface layers from the Washout Plant. The removed surface material and abrasive are collected and placed in appropriate containers for treatment and/or disposal. The building is then cleaned of residual dust by vacuuming and/or water washing. If necessary, secondary decontamination is performed to remove contaminants that have penetrated building materials beyond the surface layer. Although the process is technically feasible for removing the surface contamination in the building, the process option was eliminated due to safety concerns because of the possibility of dust explosions and the potential for the airborne spread of contaminants. A very similar process (hydroblasting) with much less potential for dust explosion or airborne spread of contaminants was instead chosen for further evaluation.

*Hydroblasting/Waterwashing* – A high-pressure (500 to 50,000 psi) water jet is used to remove contaminated debris from surfaces. The removed surface debris and spent water are collected in a sump and treated to separate the solids. The water is recycled to storage tanks where makeup water is added. The collected water and debris may have to be disposed of as a hazardous waste or be treated for contamination onsite. Secondary decontamination techniques may be required to remove subsurface contamination. This technology was considered applicable for all surface and near surface contamination (within 2 cm of the surface). In addition, the technology has been used for treating other explosive contaminated buildings.

*Scarification –* This technique is capable of removing up to 2.5 cm of surface layer from concrete or similar materials. The scarifier tool, (e.g., Scabbler, MacDonald Air Tool Corp., Hackensack, New Jersey) consists of pneumatically operated piston heads that strike the surface, causing concrete to chip off. The piston heads consist of multipoint tungsten carbide bits. The removed contaminated debris must be collected with a vacuum or some other system and packaged for either treatment (by incineration or other technique) or disposal. A secondary decontamination treatment would then be necessary to remove any remaining contaminants that have penetrated deep into the concrete (more than 2.5 cm). This technology is only applicable to the surface contamination of the concrete and poses a safety hazard due to the potential existence and possible detonation of pockets of explosives.

*Drilling and Spalling –* The drilling and spalling technique can remove up to 5 cm of surface from concrete or similar materials. Holes to 4 cm in diameter, approximately 7.5 cm deep, and 30 cm apart are drilled into the concrete surface. Hydraulically operated spalling tools are inserted into the holes; the spalling tool bit is an expandable tube of the same diameter as the hole. A tapered mandril is hydraulically forced into the hole to spread the fingers and spall off the concrete. The removed concrete is collected and, if necessary, a secondary treatment is then performed to remove any remaining contaminants that have penetrated deeper than 5 cm. Surface capping is performed last. This process option was eliminated because while it would remove all the potentially contaminated concrete it would be considered a safety hazard due to the potential existence and possible detonation of pockets of explosives.

*K-20 Sealant –* This process option seals the contamination by applying a material that penetrates a porous surface and immobilizes contaminants in place. One example of a sealant is a newly developed commercial product, K-20 (Lopat Enterprises, Inc., Wanamassa, New Jersey). This material, which was originally developed as a waterproofing agent, is now being marketed as a building decontaminant. The manufacturer claims that the product is nontoxic, noncorrosive, nonvolatile, and odorless. The K-20 sealant is similar to the encapsulation option and was eliminated as an option because, like encapsulation, after the plant was demolished the sealant would no longer effectively immobilize the contaminants.

*Cold Solvent Washing –* For remediation of building surfaces, solvent is introduced into a box placed against the wall, floor, or ceiling. The side of the box facing the area to be cleaned is open with all edges sealed. The solvent is allowed to circulate and penetrate (wet) the surface to dissolve and remove the contaminant. The contaminated solvent is collected at the bottom of the box, passed through a filter or packed carbon bed, and recycled.

The system can also be set up to circulate solvent through the process equipment in order to remove any explosives. Multiple solvent washes and/or some type of secondary treatment may be needed for total removal of the contaminants. Water-wash after decontamination may be necessary to remove the solvent contained in porous materials. Alternatively, heating may be used to volatilize any residual solvent. This process was considered potentially applicable and was kept in the FS evaluation.

*RadKleen/Solvent Washing –* Fluorocarbon extraction of contaminants from building materials involves the pressure-spraying of a fluorocarbon solvent onto the contaminated surface followed by collection and purification of the solvent. RadKleen (Health Physics Systems, Inc., Gainesville, Florida) is an example of a commercial process that uses

Freon 113 (1,1,2-trichloro-1,2,2-trifluoroethane or $C_2F_3Cl_3$) as the solvent. This technology was eliminated from further evaluation because of the potential air emissions.

*Solvent Wiping* – This option involves wiping non-porous contaminated surfaces with a solvent wet cloth. The process would be used for cleaning the outside of the process equipment with surface contamination. Solvent wiping could also be used on the inside of larger equipment where access was easy and the surface not extensively corroded. This process option was retained for further evaluation. The solvent wet cloths would be packaged and sent offsite for incineration.

*Vapor-Phase Solvent Extraction* – An organic solvent with a relatively low boiling point (such as acetone) is vaporized in a boiler external to the building. The vapors enter the building through a series of insulated pipes and vents. The solvent permeates through the building, condensing as it cools below the boiling point. The contaminant-laden liquid solvent is collected in a sump, from which it is pumped to a waste treatment system, where the contaminants are removed. The solvent is then recycled to the boiler. Cleanup entails washing the walls with water or heating to volatilize the residual solvent. This process was eliminated from further consideration because it presents health, fire, and explosion hazards and would be more costly than cold solvent washing and no more effective.

*Acid Etching* – Acid is applied to a contaminated surface to promote corrosion and removal of the surface layer. The resulting debris is then neutralized and disposed of. Thermal or chemical treatment of the removed material may be required to destroy the contaminant before disposal. The process was eliminated from further consideration because of potential operator safety hazards and its inability to work on concrete and galvanized steel or aluminum.

**Remediation (Chemical Treatment).** Chemical treatment methods involve the use of oxidizing and/or reducing agents to selectively convert organic compounds to less hazardous forms. The process options considered under this treatment category were found to be either technically inappropriate for the contaminants of concern or not applicable to the media in the building and were eliminated from further consideration.

*Bleaching* – Bleach formulations are applied to a contaminated surface, allowed to react with contaminants, and removed. Application usually occurs in conjunction with other decontamination efforts, such as the use of absorbents and/or waterwashing. Bleaching was found not to be applicable to the treatment of explosives; therefore, the option was eliminated from further consideration.

*Microbial Degradation* – This process has not been applied to buildings or equipment. If it were, it is anticipated that the microbial solution would be applied to the contaminated area with a spray gun, brush, or roller. The microbes would be allowed to penetrate and react with the contaminants. After complete reaction, a detergent or solvent wash would remove the reaction products and a major portion of the microbes. Drying should result in the destruction of residual microbes; if not, heating or a chemical treatment (such as acid wash or surfactant wash) might be needed to inactivate the microbes. Finally, a wash with fresh solvent may be a necessary secondary decontamination treatment to remove any remaining contaminants or derivatives. Unless the proper biological environment (moisture, temperature and nutrients) could be maintained at the surface being treated, it is unlikely that this would be a viable technology. Consequently, this technology was eliminated from further consideration.

*Photochemical Degradation* – In this process, intense ultraviolet (UV) light is applied to a contaminated surface for some period of time. Photodegradation of the contaminant follows. In recent years, attention has been focused on this method because of its usefulness in degrading chlorinated dioxins (TCDD in particular). Three conditions have been found to be essential for the process to proceed: (1) the ability of the compound to absorb light energy; (2) the availability of light at appropriate wavelengths and intensity; and (3) the presence of a hydrogen donor. This is an innovative technology that has not been tested sufficiently to be included in the evaluation.

**Remediation Treatment (Thermal Treatment).** Thermal treatment is the thermodynamic oxidation at elevated temperatures of combustible organic compounds or the volatilization of the contaminant followed by combustion of the volatilized contaminant in an afterburner. Four process options were considered for thermal treatment and only hot gas decontamination and incineration were selected for further evaluation. One technology (flaming) was eliminated because of the media to be treated. A second technology, steam cleaning, was eliminated because it had been used previously to clean the building to its current level of contamination.

*Steam Cleaning* – Steam cleaning physically extracts contaminants from building materials and equipment surfaces. The steam is applied by hand-held wands or automated systems, and the condensate is collected for treatment. This process option was used originally when the Washout Plant was shut down, and it was believed that steam cleaning the plant again would not reduce the contamination further; therefore, the technology was eliminated from further consideration.

*Flaming* – Controlled high temperature flames are applied to noncombustible surfaces to thermally degrade all contaminants. This technology is more destructive to materials than oven heating or hot gas decontamination, and the process is only effective for surface decontamination. In most cases, solvent wiping would be much safer and less expensive where surface treatment alone were required. Nevertheless, because of Army regulations (discussed in Section 2.2.2.1), it may be necessary to employ this treatment to allow disposal of the equipment under several of the selected remediation alternatives. Remote operated flaming would be the method of choice for remediation of the concrete washout water sump.

*Hot Gas Decontamination* – The hot gas decontamination process entails insulating the building to be decontaminated and blowing air heated to 900°F into the building. The surfaces of the building and equipment are heated to approximately 500°F, and the contaminants are volatilized and destroyed in an afterburner. The process has been tested at a full-scale level for both buildings and process equipment contaminated with explosives. This option was retained for further evaluation.

*Incineration* – The building would be demolished and the various media would be fed to the incinerator, where the organic material would be combusted at high temperature. The process was considered applicable only for concrete rubble that could be fed to the system.

**Dismantling/Demolition.** Dismantling of the equipment and demolition of the Washout Plant were considered to be necessary for any alternative and were carried through to be used in conjunction with potential ex-situ treatment and disposal alternatives.

**Disposal**. If the building is demolished, the building materials will require disposal whether they are treated (remediated) prior to demolition, after demolition, or not at all. The pretreatment operations, including solvent wiping and cold solvent internal solvent flushing (washing) of the process equipment and piping, will significantly reduce the level of surface contamination of the (metal) building materials and process equipment. It will not, however, necessarily reduce the level of contamination sufficiently to meet the preliminary remediation goals (PRGs). The various treatment alternatives will remediate the building and process equipment to levels of surface and internal residual contamination lower than the PRGs stated in Table 2-1. The method of disposal chosen for each alternative may well be dictated by the degree to which the materials have been decontaminated as well as the alternative chosen for remediation.

For materials meeting the PRGs, non-metal building debris would probably be landfilled onsite and metals released to the DRMO or to the public as scrap. For materials low in residual contamination, but not meeting PRGs, off-site landfill (in a Subtitle C landfill) or on-site landfill in the Active Landfill were considered as options. This latter option was considered as a means to meet Army requirements that explosives-contaminated material not treated to the XXXXX level not be released to the public.

Off-site disposal in a hazardous or solid waste landfill for unremediated materials was considered to be a concern, however, for two reasons: 1) EPA, Oregon DEQ, and the Army have expressed a preference for on-site remediation, reflecting EPA's and Oregon DEQ's policy to pursue response actions that involve treatment versus land disposal; and (2) Army regulations require the decontamination of debris or equipment to a XXXXX level before it is released to the public sector. However, because of the need to look at a full range of alternatives and the difficulties presented in disposing of the contaminated materials, both on-site disposal in the Active Landfill and off-site disposal in a Subtitle C landfill were retained as options for the disposal of contaminated process equipment and building materials.

### 2.4.2 Evaluation and Selection of Representative Technologies

Figure 2-2 shows the general response actions, technologies and process options remaining after the preliminary screening. These technologies and process options are considered in greater detail below according to the criteria of effectiveness, implementability, and cost. Brief descriptions of each of these criteria are presented below.

The effectiveness of the process options was evaluated based on: (1) the potential effectiveness of the process option in handling the estimated areas or volumes of media and meeting the preliminary remediation goals; (2) the potential impacts to human health and the environment during the construction and implementation phase; and (3) how proven and reliable the process is with respect to the contaminants and conditions at the site.

## Figure 2-2: Applicable Remedial Technologies and Process Options

| General Response Action | Remedial Technology | Process Option | Effectiveness | Implementability | Cost |
|---|---|---|---|---|---|
| No Action | None | Not Applicable | Does not effect the toxicity, mobility, or volume of contamination. | Easily implemented. Additional evaluation required per NCP. Does not meet ARARs. | Cost is low. |
| Institutional Control | Disposal of Sump Contents and Controlled Access | Burn Sludge/Compost Contaminated Water/Fence Washout Plant | Eliminates risk from sump, and risk from Washout Plant is below PRGs. | Easily implemented. | Cost is low. |
| Remediation Treatment | Physical Treatment | Hydroblasting/ Waterwashing | Effectively reduces the volume of contaminated materials, but does not effect the toxicity or mobility of contamination. Effective on the concrete surface, and exterior of equipment. | Building will have to be contained to ensure that contaminated water does not escape. Water and debris will need treatment. Options can not be implemented alone and meet RAO for equipment interior. | Cost would be moderate due to the need for residual treatment. |
| | | Cold Solvent Washing | Effectively reduces the volume of contaminated materials, but does not affect the toxicity or mobility of contamination. Effective on the inside of equipment. | Contaminated solvents will have to be disposed of. | Cost would be moderate due to the need for residual treatment. |
| | | Solvent Wiping | Effectively reduces the volume of contaminated materials, but does not affect the toxicity or mobility of contamination. Effective only on non-porous surfaces. | Implementation is limited to surface removal of contamination from metal sheeting and the exterior of equipment. Option cannot be implemented alone and meet RAO for equipment interior. | Cost would be low. |
| | | Dusting, Vacuuming, Scraping & Wiping | Very effective (as pretreatment) for removal of loose material | Easily implemented. | Cost would be low. |
| Remediation Treatment | Thermal Treatment | Hot Gas Decontamination | Effectively reduces the volume of contaminated materials, and reduces the toxicity and mobility of contamination. Effective on all the contaminated media. | Full-scale implementation demonstrated on explosives contaminated buildings and equipment. Can be implemented alone and meet RAO. | Capital costs would be high. |
| | | Incineration | Effectively reduces toxicity, volume and mobility of contaminated material that can be fed to incineration system. | Process is widely used, but requires extensive permitting and a trial burn. | Cost is very high. |
| Dismantling | Dismantling | Equipment Disassembly | Required at the conclusion of the remediation. | Implementation will have to consider the possibility of pockets of explosives if equipment is not remediated prior to disassembly. | Cost would be low if equipment is remediated prior to disassembly, but the cost would rise significantly if disassembly occurs before remediation. |
| Demolition | Demolition | Building Demolition | Required at the conclusion of the remediation. | Building demolition will be easily implemented if remediation has been performed first. If not the building will have to be contained to avoid spreading contamination. | Cost would be moderate if building is remediated prior to demolition, **but the cost would rise significantly if demolition occurs before remediation.** |
| Disposal | On-site Disposal | Disposal of Contaminated Materials | Does not affect the toxicity or volume of contaminated materials. Will reduce potential for exposure to contamination through reduction in mobility. | Disposal of contaminated materials might not meet Army regulations. | Cost would be low. |
| | | Disposal of Decontaminated Rubble | Required at the conclusion of the remediation. | Disposal of remediated rubble will be easily implemented. | Cost would be low if building material is remediated prior to disposal. |
| | Off-site Disposal | Disposal of Contaminated Rubble & Equipment | Does not affect the toxicity or volume of contaminated materials. Will reduce potential for exposure to contamination through reduction in mobility. | Disposal of contaminated rubble may be difficult to implement due to LDR and Army requirements for treatment prior to the release of explosives contaminated materials. | Cost would be high in comparison with the cost of on-site landfilling of remediated materials. |
| | | Disposal of Decontaminated Metal Materials as Scrap | Method of choice for disposal of metal materials. | Metal materials must meet Army XXXXX criteria. | Cost would be very low. |

Source: Arthur D. Little, Inc.

The implementability of the process option encompasses both the technical and administrative feasibility of implementing the option. Technical implementability was the major criteria used for screening the process options in the preliminary screening to eliminate those that were clearly not applicable to the contaminants or the contaminated media. Therefore, this evaluation places greater emphasis on the institutional aspects of implementability, such as the ability to obtain necessary permits for off-site actions; the availability of treatment, storage, and disposal services; and the availability of skilled workers to implement the technology.

The cost evaluation plays a limited role in the screening of process options. The costs that are developed are relative in nature and not detailed. These costs are usually developed based on engineering judgment, and each process is evaluated as to whether costs are high, medium, or low with respect to the other process options.

***2.4.2.1 No Action.*** The No Action general response action involves no technology, requires no implementation, is not effective in reducing the toxicity, mobility, or volume of the waste, and incurs no direct cost. Some natural degradation of explosives might occur, but based on their continued presence 25 years after the suspension of operations in the Washout Plant, the rate of recovery is expected to be slow. This alternative is included as a requirement of the NCP and provides a baseline for comparison with the other technologies.

***2.4.2.2 Hydroblasting/Water Washing.*** Hydroblasting would be effective for the treatment of the outside of the process equipment and the internals of some of the equipment. Hydroblasting would also be effective for the removal of the surface contamination from the steel and aluminum sheeting and the concrete. However in both cases, the mobility and toxicity of the removed contaminants would not be effected; only the volume or the media effected would be changed. Because the contaminants are transferred to another media (the water) or retained in the current media (concrete dust), the residuals from the process would have to be treated by carbon adsorption for the wastewater and off-site disposal, solidification/stabilization technology, or a destructive technology for the concrete dust (and abrasive).

The technology would be easily implemented at UMDA and the treatment could be performed by either UMDA personnel or a local contractor, however, the option cannot meet the remedial action objectives without using an additional technology to remediate the interior of the process equipment. The only difficulty in implementation would be ensuring that the concrete dust and the wastewater were contained in the building and were not allowed to escape to the environment.

The cost of hydroblasting would be moderate with respect to the other options due to the need for residual treatment.

In summary, hydroblasting is retained for further consideration to remediate the concrete and the outside of the process equipment.

***2.4.2.3 Cold Solvent Washing.*** Cold solvent washing would effectively remove most of the explosive in the interior of the process equipment. Specifically it could be used to remove any pockets of detonable quantities of explosives that might be remaining within the process equipment, but its ability to remove the explosives on the surface of the equipment is questionable. There are several concerns with using solvent washing on media other than the internals of the process equipment:

- On concrete the solvent washing may drive the contamination deeper into the masonry and cause additional contamination.

- The outside of the process equipment is painted and the contamination may be absorbed into the paint and solvent washing would not be effective on the contaminants absorbed in the paint. The solvent wash system for the exterior of the process equipment would be very difficult to implement.

- The solvent wash system would be effective on the steel and aluminum sheeting but the implementation of the system would not be practical. For this media, solvent wiping would provide the same level of effectiveness and would be easily implemented. The metal sheeting in the washout building has also been assumed not to be contaminated and would not require solvent washing. Solvent wiping would be used for any localized contamination on the sheeting.

As stated above, the process option would not be easily implemented on the exterior of the process equipment and the steel and aluminum sheeting, but could be readily implemented on the internals of the process equipment. The use of solvent washing on the internals of the process equipment would be safe for the operators and would safely contain the solvents within the process equipment and out of the environment. The only difficult implementation problem would be the disposal of the solvents after use.

The cost of the solvent washing system would be moderate with respect to the other technologies due to the need for treating the waste solvents.

In summary, solvent washing is retained for further consideration to remediate the internals of the process equipment.

***2.4.2.4 Solvent Wiping.*** Solvent wiping is identical technically to solvent washing and will be effective on the same media and contaminants; however, the implementation of solvent wiping is different, and it will be more easily implemented on the metal surface of the sheeting or unpainted equipment than solvent washing. Most of the sheeting has been assumed to be uncontaminated, so solvent wiping would be an effective process option to remediate any localized contamination. Because solvent wiping is only effective and implementable on the metal sheeting and the exterior of the process equipment, it will be necessary to group it with other process options to make it effective for meeting the remedial action objectives for the different media.

The cost of the solvent wiping will be minor with respect to the other technologies.

In summary, solvent wiping is retained for further consideration to remediate the steel and aluminum sheeting and the outside of any process equipment.

***2.4.2.5 Hot Gas Decontamination.*** Hot gas decontamination is the only process option that is capable of reducing the explosive contamination to below detection limits (0.02 µg/sq cm), which, in turn, are well below the PRGs (0.5-460 µg/sq cm). Hot gas is also the process option that will most significantly reduce the toxicity, mobility, and volume of the contamination. The results of past demonstration tests show that the hot gas system would be capable of remediating the surface contamination on the outside and inside of the process equipment to detection limits, remediating the surface contamination of the concrete and metal sheeting to detection limits, and remediating the internal portion of the concrete floor and wall to close to detection limits. Hot gas decontamination or flaming are the only technologies that meet AMCCOM's preference for thermal decontamination prior to general use or release to the public.

Implementation of the hot gas process would be slightly more complex than the other process options because of the need for insulating the building and setting up the air heater and afterburner. The major portion of the metal sheeting in the washout building has been assumed not to be contaminated and solvent wiping would be used for any localized contamination on the sheeting. The metal sheeting in the pelletizing building would be remediated with hot gas decontamination.

The cost of the hot gas decontamination system would be higher than the cost for the other options because of the higher capital expense.

In summary, the hot gas decontamination system is retained for further consideration to remediate all the media in the Washout Plant.

***2.4.2.6 Dismantling/Demolition.*** Dismantling of the equipment followed by demolition of the Washout Plant is not being considered as a process option by itself for the remediation of the plant but would be a necessary part of any alternative that is to be evaluated (except No Action and Controlled Access). Conventional demolition of the plant would be an effective and appropriate method for removing the building from the site.

The dismantling of the equipment and demolition of the Washout Plant should be straightforward and easily implemented. The equipment is not complex and the plant is relatively small in size. If the building and equipment are treated prior to demolition there should be no concern of having a release to the environment; however, if the dismantling and demolition take place without treatment, then care will have to be taken to minimize the spread of contaminants to the environment and for the safety of the operators dismantling the equipment and demolishing the building. Specifically, care will have to be taken with regard to any pockets of explosives remaining in the equipment. Because of this safety concern, it would not be appropriate to dismantle the equipment if solvent washing was not performed first as part of the pretreatment operations.

A second concern regarding the demolition of the building is the possibility of contaminated soil under the building. Because of this possibility, soil samples should be taken after the building is demolished and the soil should be treated, in a subsequent operable unit, if it is found to be contaminated with explosives.

The cost of dismantling/demolition should be moderate if the remediation of the process equipment and building is performed prior to dismantling/demolition; however, the costs could go up significantly if the dismantling/demolition is performed without treatment first. This increase in cost is caused by the need for containment of the contaminated dust generated during the demolition and protection for the workers during demolition.

In summary, dismantling/demolition is retained for further consideration to remove the process equipment and building either before or after the Washout Plant has been remediated.

***2.4.2.7 On-Site Disposal.*** On-site disposal of fully decontaminated non-metal building debris by landfill should be easily and inexpensively accomplished. It would also best meet EPA, Oregon DEQ, and Army preference for on-site remediation.

On-site disposal by landfill of materials (building debris and process equipment) low in residual contamination, but not necessarily meeting the PRGs, may be possible if an indicating reagent wipe test (such as Webster's or Griess reagent) is used to determine the presence or absence of TNT or RDX on a surface. Currently, materials potentially exposed to TNT, but testing negative to Webster's reagent, are being disposed of in the Active Landfill at UMDA. Solvent washing and solvent wiping of the Washout Plant equipment should reduce the surface contamination (inside and out) to below the detectable level by reagent wipe test (1–10 µg/sq cm) but not necessarily by wipe test/HPLC analysis (0.02–0.03 µg/sq cm). A residual internal surface explosive contamination concentration in the process equipment and piping below about 10 µg/sq cm should pose a hazard neither to the environment nor to human health if these materials were landfilled.

Therefore, disposal of remediated building residuals and equipment onsite will be retained for further consideration.

***2.4.2.8 Off-Site Disposal.*** Off-site disposal of materials low in residual contamination, but not meeting the PRGs is currently another possible option. Chemical Waste Management, Inc., has indicated they can accept building debris and contaminated process equipment, that contains less than detonable or reactive quantities of explosives for landfill at a site in Oregon up until at least May 8, 1994.

The administrative implementability of off-site disposal of contaminated materials may be difficult , however, because: (1) EPA, Oregon DEQ, and the Army have expressed a preference for on-site remediation, reflecting EPA's and Oregon DEQ's policy to pursue response actions that involve treatment versus land disposal; and (2) Army regulations require the decontamination of explosive-contaminated materials (debris or equipment) before it is released to the public sector.

If all the surfaces of the process equipment and piping (1) could be made accessible through disassembly and the mechanical cutting open of vessels and tanks (previously cleaned by solvent washing and refilled with water for the cutting operations) and (2) tested negative by reagent test when the surfaces were wipe sampled for residual explosives, it might be possible to have an SOP approved by AMCCOM that would allow disposal of the equipment offsite by Subtitle C landfill or as scrap metal. If a SOP for decontamination based on reagent wipe sampling of the equipment alone cannot be agreed upon by the remediation contractor, safety personnel, and AMCCOM, then it may be necessary to cut open the equipment and subject it to flaming (flashing) or oven

heating the materials (at a government facility) before release for off-site landfill or sale as scrap metal. Oven heating of process equipment to assure decontamination of explosives is standard practice at many explosive production facilities. No such facilities exist at UMDA, however, so it would probably be necessary to transfer the process equipment to a government controlled or operated explosive production facility for exercising this option.

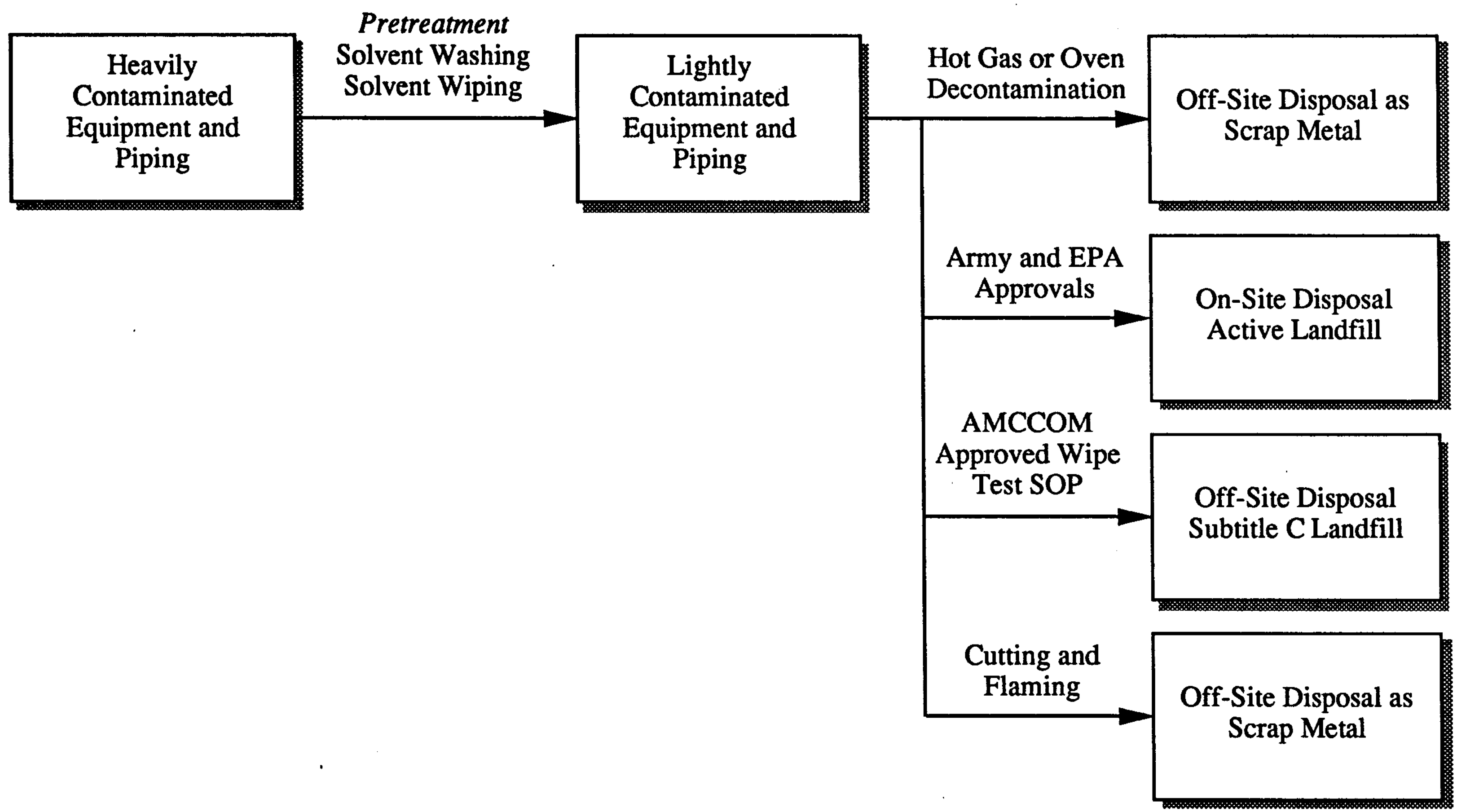
Figure 2-3 depicts a decision tree leading to disposal options for the contaminated process equipment and piping.

Off-site disposal of decontaminated metal building materials and process equipment through a DRMO or release to the public as metal scrap is the method preferred for disposal by the EPA, Oregon DEQ and the Army.

The cost of off-site disposal of contaminated materials will be high in comparison to the disposal of remediated materials onsite or decontaminated materials (metals) offsite.

In summary, off-site disposal of contaminated wastes will be difficult to implement from an administrative point of view; however, the option will be retained to provide a range of options for the development of alternatives.

**Figure 2-3: Treatment/Disposal Options Decision Tree for Process Equipment and Piping**



## 3.0 Development and Screening of Alternatives

### 3.1 Development of Alternatives

After the preliminary screening of the technologies, the applicable process options for the remaining technologies were identified and evaluated for effectiveness, implementability, and cost. As a result of this evaluation, a process option was selected for each technology type, and the process options were formed into alternatives for remediating the Washout Plant. Five major alternatives (and two variations on Alternatives 4 and 5) were developed from the process options:

- Alternative 1 - No Action
- Alternative 2- Sump Cleanout/Controlled Access
- Alternative 3- Hydroblasting, Inspection, Demolition, and Disposal
- Alternative 4A - Hot Gas Decontamination, Demolition, and Disposal
- Alternative 4B - Hot Gas Decontamination, Partial Demolition, and Disposal
- Alternative 5A - Demolition, Inspection, and Disposal
- Alternative 5B - Demolition, Inspection, Concrete Incineration and Disposal

Each of these Alternatives (with the exception of Alternatives 1 and 2) would be preceded by a series of pretreatment steps. These pretreatment steps would include the following:

- Dusting, vacuuming, scraping and wiping of pigeon droppings
- Removal of electrical controls and wiring
- Asbestos removal and disposal
- Solvent wiping of corrugated metal siding, structural steel and process equipment exterior
- Internal solvent flushing (washing) of process equipment
- Removal and disposal of sludge and water from explosive washout water overflow sump

The detailed description of the alternative development phase is presented in the remaining sections following the outline provided by EPA in the *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA*.[3]

In developing alternatives, general response actions and the process options chosen to represent the various technology types for each media were combined to form a treatment for the site as a whole. As demonstrated in the final screening, none of the process options were capable of remediating all the media in the Washout Plant alone; therefore, the different process options were developed into five alternatives as shown in Figure 3-1. Since the number of process options was limited, no further screening of alternatives was conducted; consequently, all five major alternatives were taken to the "Detailed Analysis" phase.

- Alternative 1 – No Action.

- Alternative 2 – Sump Cleanout/Controlled Access. This alternative consists of first removing and disposing of the explosive sludge and contaminated water from the washout water sump. The explosive sludge would be dried and burned in the ADA area of UMDA. The contaminated water would be added to the compost piles being used for remediation of the Washout Lagoon soil. The washout water sump would then be remotely flamed and moved to the concrete pad in front of the Washout Plant and the Washout Plant and concrete pad fenced in to control access or demolished and landfilled onsite.

## Figure 3-1: Development of Alternatives for the Three Media in the Washout Plant

| Media | Process Option | Area or Volume | Alt. 1 No Action | Alt. 2 Partial Remediation Controlled Access | Alt. 3 Hydroblasting | Alt. 4A Hot Gas Decon/ Total Demolition | Alt. 4B Hot Gas Decon/ Partial Demolition | Alt. 5A Demolition/ Disposal | Alt. 5B Demolition, Concrete Incineration, and Disposal |
|---|---|---|---|---|---|---|---|---|---|
| Process Equipment | No Action | All Process Equipment | ■ | ■ | | | | | |
| | Hydroblasting | Internal | | | | | | | |
| | | External | | | ■ | | | | |
| | Solvent Washing | Internal | | | ■ | ■ | ■ | ■ | ■ |
| | | External | | | | | | | |
| | Solvent Wiping | Internal | | | | | | | |
| | | External | | | | | | | |
| | Hot Gas Decon | Internal | | | | ■ | ■ | | |
| | | External | | | | ■ | ■ | | |
| | Dismantling | All Process Equipment | | | ■ | ■ | ■ | ■ | ■ |
| | On-Site Disposal by Landfill | All Process Equipment | | | ■ | | | ■ | ■ |
| | Off-Site Disposal as Scrap Metal | All Process Equipment | | | | ■ | ■ | | |
| | Off-Site Disposal by Landfill | | | | ■ | | | ■ | ■ |
| Concrete | No Action | All Concrete | ■ | ■ | | | | | |
| | Hydroblasting | Internal | | | | | | | |
| | | External | | | ■ | | | | |
| | Solvent Washing | Internal | | | | | | | |
| | | External | | | | | | | |
| | Solvent Wiping | Internal | | | | | | | |
| | | External | | | | | | | |
| | Hot Gas Decon | Internal | | | | ■ | ■ | | |
| | | External | | | | ■ | ■ | | |
| | Demolition | All Concrete | | | ■ | ■ | | ■ | ■ |
| | On-Site Disposal | All Concrete | | | ■ | ■ | | ■ | ■ |
| | Off-Site Disposal | All Concrete | | | | | | ■ | |
| Metal Sheeting and Structural Steel | No Action | All Sheeting | ■ | ■ | | | | | |
| | Hydroblasting | External | | | | | | | |
| | Solvent Washing | External | | | | | | | |
| | Solvent Wiping | External | | | ■ | ■ | ■ | ■ | ■ |
| | Hot Gas Decon | External | | | | ■ | ■ | | |
| | Demolition | All Sheeting | | | ■ | ■ | | ■ | ■ |
| | On-Site Disposal | All Sheeting | | | | | | | |
| | Off-Site Disposal as Scrap Metal | All Sheeting | | | ■ | ■ | ■ | ■ | ■ |

Source: Arthur D. Little, Inc.

Key: ☐ Potentially Applicable
☐ Not Applicable

- Alternative 3 – Hydroblasting. This alternative consists of hydroblasting the concrete and the outside of the process equipment along with solvent washing the internals of the process equipment and solvent wiping the metal sheeting. The water from the hydroblasting operation will be allowed to settle to remove any concrete or paint debris and then passed through a carbon filter to remove any explosive contamination. The settled debris, the contaminated solvent, and the contaminated carbon will be sent offsite for disposal. The treated water would be discharged to the ground onsite. After hydroblasting, the building would be demolished and the concrete rubble landfilled onsite at UMDA. The process equipment would be tested for residual explosive and then landfilled onsite or offsite. The metal building materials would be disposed of as scrap.

- Alternative 4A – Hot Gas Decontamination/Total Demolition. This alternative consists of performing hot gas decontamination on all the media on both floors of the pelletizer building and on the process equipment and the floor of the washout building. The sump and the metal trough would also be remediated with one of the two buildings. As part of the pretreatment operations, the interior of the process equipment would be solvent washed prior to remediation. The contaminated solvent would be the only residual from this alternative, and the possibility exists for burning it in the hot air burner, thus assuring no residuals for further treatment. The entire building would be demolished and the concrete rubble landfilled onsite. Metal building materials and process equipment would be sold as scrap.

- Alternative 4B – Hot Gas Decontamination/Partial Demolition. This alternative consists of performing hot gas decontamination on all the media on both floors of the pelletizer building and on the process equipment and the floor of the washout building. The sump and the metal trough would also be remediated with one of the two buildings. As part of the pretreatment operations, the interior of the process equipment would be solvent washed prior to remediation. The contaminated solvent would be the only residual from this alternative, and the possibility exists for burning it in the hot air burner, thus assuring no residuals for further treatment. The pelletizer building of the Washout Plant would be demolished and the concrete rubble landfilled onsite. The washout building of the Washout Plant would be retained for future use. The decontaminated metal building materials and process equipment would be sold as scrap.

- Alternative 5A – Demolition and Disposal. This alternative consists of solvent washing the interior of the process equipment during pretreatment to remove most of the explosives followed by disassembly of the process equipment and demolition of the Washout Plant. The equipment and building debris would be tested for residual explosive and then be transported to an on-site or off-site landfill.

- Alternative 5B – Demolition, Concrete Incineration, and Disposal. This alternative would be the same as Alternative 4 except the concrete rubble from demolition would be incinerated (onsite) in a rotary kiln and then landfilled onsite.

More detailed descriptions of these alternatives are presented in Section 4.0, Detailed Analysis of Alternatives.

## 4.0 Detailed Analysis of Alternatives

### 4.1 Introduction

This section presents a description and detailed evaluation of each of the five major alternatives (and two variations on Alternatives 4 and 5) that were developed following the preliminary remedial action screening. These alternatives are:

- Alternative 1 - No Action
- Alternative 2 - Sump Cleanout/Controlled Access
- Alternative 3 - Hydroblasting, Inspection, Demolition, and Disposal
- Alternative 4A - Hot Gas Decontamination, Demolition, and Disposal
- Alternative 4B - Hot Gas Decontamination, Partial Demolition, and Disposal
- Alternative 5A - Demolition, Inspection, and Disposal of Contaminated Materials
- Alternative 5B - Demolition, Inspection, Concrete Incineration, and Disposal

All these alternatives (with the exception of Alternatives 1 and 2) would be preceded by the following pretreatment steps:

- Dusting, vacuuming, scraping, and wiping of pigeon droppings
- Removal of electrical controls and wiring
- Asbestos removal and disposal
- Solvent wiping of corrugated metal siding, structural steel, and process equipment exterior
- Internal solvent flushing (washing) of process equipment
- Removal and disposal of sludge and water from washout water overflow sump and flaming of washout water sump to remove residual explosive

The purpose of the section is to present information relevant to selecting an appropriate remedy for the Explosive Washout Plant. The analyses were performed in accordance with the requirements of the NCP, CERCLA, SARA, and the *Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*. The analyses are also based on the institutional and technical criteria presented in Section 2.0.

#### 4.1.1 CERCLA Evaluation Criteria

The detailed analysis of alternatives consists of the evaluation and presentation of the relevant information needed to allow decision makers to select a site remedy. In developing this analysis there are five specific statutory requirements for remedial actions that must be addressed, including:

- Protection of human health and the environment
- Attainment of ARARs (or providing grounds for invoking a waiver)
- Cost-effectiveness
- Use of permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable
- Preference for treatment that reduces toxicity, mobility, and/or volume as the principal element

In addition, CERCLA places an emphasis on evaluating long-term effectiveness and related considerations for each of the alternatives, including:

- The long-term uncertainties associated with land disposal
- The goals, objectives, and requirements of the Solid Waste Disposal Act
- The persistence, toxicity, and mobility of hazardous substances and their constituents, and their propensity to bioaccumulate
- Short- and long-term potential for adverse health effects from human exposure
- Long-term maintenance costs
- The potential for future remedial action costs if the alternative remedial action in question were to fail
- The potential threat to human health and the environment associated with excavation, transportation, and redisposal, or containment

Each of these requirements and considerations were then combined in the NCP, and nine evaluation criteria were developed to address the intent of the requirements and considerations and other technical and policy considerations that have proven to be important for selecting remedial alternatives. These nine evaluation criteria have served as the basis for conducting the detailed analysis of the five alternatives for the remediation of the Washout Plant. In order to ensure that the appropriate weight was applied to each of the criteria, the NCP divides the nine criteria into three groups (Figure 4-1): (1) Threshold Criteria; (2) Primary Balancing Criteria; and (3) Modifying Criteria.

***4.1.1.1 Threshold Criteria.*** Two of the criteria relate directly to statutory requirements that must ultimately be satisfied in the ROD. They are categorized as threshold criteria because any alternative selected to remediate the Explosives Washout Plant must meet them. They can be described as follows:

- Overall Protection of Human Health and the Environment - Describes how each alternative, as a whole, achieves and maintains protection of human health and the environment. This assessment draws on the assessments conducted under other evaluation criteria, especially long-term and short-term effectiveness and compliance with ARARs. It focuses on whether a specific alternative achieves adequate protection and describes how site risks are eliminated, reduced or controlled through treatment, engineering, or institutional controls.

- Compliance with ARARs - Describes how each alternative complies with ARARs, or if a waiver is required and how it is justified. The assessment also addresses other information from advisories, criteria, and guidance that the agencies agree is "to be considered." The detailed analysis summarizes which federal and State of Oregon requirements are applicable or relevant and appropriate for the specific alternative and how the alternative meets these requirements.

***4.1.1.2 Primary Balancing Criteria.*** Five of the criteria are grouped together because they represent the primary factors upon which the analysis is based, taking into account technical, cost, institutional, and risk concerns.

**Figure 4-1: Criteria for Detailed Analysis of Alternatives**

**Threshold Criteria**

**OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT**

- How Alternative Provides Human Health and Environmental Protection

**COMPLIANCE WITH ARARs**

- Compliance with Chemical-Specific ARARs
- Compliance with Action-Specific ARARs
- Compliance with Location-Specific ARARS
- Compliance with Other Criteria, Advisories, and Guidances

**Primary Balancing Criteria**

**LONG-TERM EFFECTIVENESS AND PERMANENCE**

- Magnitude of Residual Risk
- Adequacy and Reliability of Controls

**REDUCTION OF TOXICITY, MOBILITY, AND VOLUME THROUGH TREATMENT**

- Treatment Process Used and Materials Treated
- Amount of Hazardous Materials Destroyed or Treated
- Degree of Expected Reductions in Toxicity, Mobility, and Volume
- Degree to Which Treatment is Irreversible
- Type and Quantity of Residuals Remaining After Treatment

**SHORT-TERM EFFECTIVENESS**

- Protection of Community During Remedial Actions
- Protection of Workers During Remedial Actions
- Environmental Impacts
- Time Until Remedial Action Objectives are Achieved

**IMPLEMENTABILITY**

- Ability to Construct and Operate the Technology
- Reliability of the Technology
- Ease of Undertaking Additional Remedial Actions, if Necessary
- Ability to Monitor Effectiveness of Remedy
- Ability to Obtain Approvals From Other Agencies
- Coordination With Other Agencies
- Availability of Necessary Equipment and Specialists
- Availability of Prospective Technologies

**COST**

- Capital Costs
- Operating and Maintenance Costs
- Present Worth Cost

**Modifying Criteria**

**STATE ACCEPTANCE**

**COMMUNITY ACCEPTANCE**

Source: EPA RI/FS Guidance Manual [3]

- Long-Term Effectiveness and Permanence - Evaluates the effectiveness of each alternative in maintaining protection of human health and the environment after response objectives have been met. This assessment considers the magnitude of the residual risk (in this case, risk from building materials or process equipment that are not treated and risk from treatment residuals, if any), measured by numerical standards where possible. It also considers the adequacy and reliability of controls.

- Reduction of Toxicity, Mobility, and Volume Through Treatment - Evaluates the anticipated performance of the specific treatment technologies each alternative might employ. Where possible, numerical comparisons before and after remediation are presented. This assessment also considers the degree to which treatment is irreversible, the type and quantity of residuals that will remain following treatment, and the degree to which the treatment reduces the inherent hazards posed by the site.

- Short-Term Effectiveness - Examines the effectiveness of each alternative in protecting public health, worker health, and the environment during the construction and implementation of a remedy until response objectives have been met. The time until protection is achieved is also considered here.

- Implementability - Evaluates the technical and administrative feasibility of each alternative and the availability of required goods and services. Technical feasibility includes the ability to construct the system used, the ability to operate and maintain the equipment, and the ability to monitor and review the effectiveness of operations. Administrative feasibility refers to the ability to obtain normal legal approvals (e.g., site access), public relations and community response, and coordination with government regulatory agencies.

- Cost - Evaluates the capital and operation and maintenance (O&M) costs of each alternative. Capital cost refers to the expenditures required to develop and construct the facilities necessary to implement the alternative. O&M cost refers to the expenditures of time and materials throughout the course of the project, including costs to lease equipment.

The level of detail required to analyze each alternative against these evaluation criteria depends on the type and complexity of the site, the type of technologies and alternatives being considered, and other project-specific considerations. This FS addresses a single site, three environmental media (concrete, metal sheeting, and process equipment), and a limited set of contaminants of concern (explosives). The detail presented in the following analyses has been focused accordingly.

***4.1.1.3 Modifying Criteria.*** In accordance with RI/FS guidance[3] the final two criteria involving state and community acceptance will be evaluated following the receipt of state agency and public comments on the FS and the Proposed Plan. The criteria are as follows:

- State (Support Agency) Acceptance - Reflects the State of Oregon's apparent preferences among or concerns regarding the alternatives.

- Community Acceptance - Reflects the local communities' apparent preferences among or concerns about alternatives.

## 4.2 Individual Analysis of Alternatives

### 4.2.1 Common Elements

The procedures that are common to all treatment alternatives (with the exception of Alternatives 1 and 2, No Action and Controlled Access) are presented here to limit redundancy in the following discussion of treatment alternatives.

***4.2.1.1 Pretreatment Requirements.*** For all of the treatment alternatives (with the exception of Alternatives 1 and 2, No Action and Controlled Access), a number of pretreatment steps would be required prior to treatment of the explosive-contaminated building and process equipment. These include the following:

- Removal of pigeon droppings
- Removal of electrical controls and wiring
- Removal of asbestos insulation
- Solvent wipe of corrugated metal siding, structural steel, and process equipment exterior
- Internal solvent flushing (washing) of process equipment
- Removal and disposal of explosive sludge and washout water from the washout water sump and flaming of washout water sump to remove residual explosive

Pigeons have nested in Building 489 since it became inactive in the 1960s, and there is an accumulation of pigeon droppings to a depth of 1/2 to 2 inches on the floors and equipment within the building. Airborne dusts that would be generated if those deposits were disturbed (during preparation for explosive decontamination treatment) could contain toxic organisms (psittaci chlamydia) that can cause respiratory disease in humans. Pretreatment for the pigeon droppings would include at a minimum, scraping and vacuuming, and, possibly, washing.

The electrical controls and instruments within Building 489 are tightly sealed having explosion proof construction and are, therefore, highly unlikely to have any internal contamination. Because some of the electrical controls and instruments contain mercury (and, possibly, PCBs), high temperature thermal decontamination processes (such as hot gas decontamination or flaming) should not be used for decontaminating the outer surfaces, since this could result in the release of toxic materials from within the electrical equipment. The exterior of the electrical equipment would instead, be cleaned by a low temperature thermal process (such as steam or hot water) or preferably by a more efficient decontamination process such as solvent wiping prior to disassembly (to remove toxic components) and disposal as scrap material. Electrical wiring and controls and equipment on the exterior of Building 489 would be disassembled, wipe sampled to confirm the absence of contamination and disposed of as scrap material.

Asbestos insulation would be removed from the process equipment using standard asbestos removal procedures (wetting and bagging by certified removal personnel in appropriate protective clothing). Any explosives contaminated asbestos should be set aside for decontamination/disposal while the uncontaminated asbestos can be disposed of directly according to local and federal regulations. Like the electrical equipment, it would be necessary to remove the asbestos insulation before (thermal) decontamination of the

building structure and equipment or demolition to prevent release of asbestos particulate. (The bonding materials for the asbestos would be destroyed in the thermal decontamination process leading to its possible release.)

Cold solvent washing would also be a common pretreatment process step for all alternatives except "No Action" and "Controlled Access." Solvent vapor cleaning (degreasing and defluxing) has been used for years by industry for cleaning parts and small equipment. More recently, cold solvent (60 to 80°F) cleaning has been used (Radkleen solvent, Freon® 113) for cleanup of radioactive materials from surfaces and small equipment and for decontamination of PCB-contaminated transformers[9] Because of the increased complexity and cost of solvent vapor or hot solvent cleaning, (internal) cold solvent washing was selected (Section 2.4, Identification and Screening of Technology Types and Process Options) as a pretreatment for the process equipment located in Building 489.

Because the explosives recovered in the washout building are not very soluble in the hot water and steam previously used to melt and convey the explosives through the plant, there is a high probability that pockets of explosives have been deposited in the process equipment. It is even possible that detonable or ignitable quantities of explosive could remain as deposits within the equipment. A major portion of these explosives could readily be removed by flushing the equipment with a solvent such as acetone or alcohol, thus reducing the explosive contamination to below detonable concentrations. Solvent (acetone or alcohol) would be pumped through enclosed equipment such as pumps, heat exchangers and piping and hand sprayed into open vessels such as the washout, settling and recirculation tanks. Several applications of solvent would be made to each piece of equipment until there was no color imparted to the solvent during the rinse with clean solvent. Solvent would be reused a number of times for the initial cleaning of pieces of equipment until the concentration of the explosive in the solvent reached approximately 0.5% by weight.

The waste solvents produced in the solvent washing step would not be an explosive hazard because relatively high concentrations of explosives in solvent (acetone or toluene) will not propagate a detonation. For example, tests by Oak Ridge National Laboratory (ORNL)[10] showed solutions of up to 75% TNT in acetone saturated with RDX (6 to 7% RDX) would not detonate. This is important from a safety standpoint both in the solvent washout step and the solvent disposal step. While the spent solvent would not be an explosive hazard, the contaminated solvent would be considered a hazardous (reactive) waste and be sent offsite for disposal by incineration. Following the washout step, the equipment would be purged with air or nitrogen to remove solvent vapors and the equipment disassembled to confirm removal of explosive.

Solvent wiping as applied to this remediation would involve the wiping of non-porous contaminated surfaces by personnel in protective equipment (gloves, apron, respirator, face shield, etc.) using solvent wetted cloths. This process would be used to clean metal siding, structural steel, walkways and ladders, electrical conduit and fixtures, and the exterior or process equipment where required. Solvent wiping of the inside of some of the larger pieces of process equipment might also be possible using air supplied respirators. It would not be necessary to solvent wipe the aluminum siding in Alternatives 4A and 4B since this siding would be decontaminated as part of the Hot

Gas Decontamination process operations. The explosive contaminated solvent wet cloths would be packaged and sent offsite for incineration.

Finally, as a part of pretreatment, the (explosive) sludge would be removed from the washout water overflow sump and burned in the UMDA burn pans or TNT burn pits (where it has been previously burned on a routine basis) or burned in the explosive burn pans in the ADA (which are permitted until the end of 1994). The water in the sump would be disposed of by adding it to the compost piles being used to treat the washout lagoon soil (which has previously been exposed to all the washout water coming from the sump and Washout Plant).

For Alternatives 2 and 5A, the washout water sump would also be flamed to remove any residual explosive. Flaming of the washout water sump would not be necessary in Alternatives 3, 4A, 4B, and 5B, because decontamination of the sump concrete would be accomplished by other means in these alternatives.

In addition to the treatment residuals generated by the remedial alternatives, there will be additional "residuals" from the pretreatment processes. These will include:

| **Pretreatment Process Residuals** | **Quantity** |
|---|---|
| Pigeon Droppings | 400 cubic feet (over a 5,000 square foot area) |
| Asbestos | 300 cubic feet (from process equipment and approximately 2,000 feet of pipe) |
| Solvent Wet Cloths (from solvent wiping) | 8 cubic feet |
| Electrical Wiring and Controls | 60 cubic feet |
| Aluminum Siding and Roofing | 2,300 square feet |
| Galvanized Steel Siding and Roof Panels | 8,300 square feet (1,000 square feet solvent wiped) |
| Waste Solvent from Cold Solvent Washing | 40 cubic feet |

***4.2.1.2 Estimated Pretreatment Costs.*** Table 4-1 presents a summary of the estimated pretreatment costs. The approximate cost for removal and disposal of the pigeon droppings (assuming the pigeon droppings can be landfilled without treatment) for 5,000 square feet of surface, at $4 per square foot of area cleaned, would be approximately $20,000. The cost for removal and disposal of asbestos from 2,000 feet of pipe at $12 per foot of pipe, plus an additional 20% for asbestos insulated equipment would be approximately $28,800. The net cost of solvent wiping and removing all electrical wiring and controls and their disposal is estimated to be $15,000. Solvent wiping of 1,000 square feet of contaminated galvanized steel siding is estimated at $2,000. Solvent wiping of 2,300 square feet of aluminum siding and roofing at $2.35 per

**Table 4-1: Estimated Pretreatment Costs for Alternatives 3 through 5B**

| | | |
|---|---|---|
| Removal and Disposal of Pigeon Droppings<br>5,000 sq ft of surface x $4 per sq ft | | $ 20,000 |
| Removal and Disposal of Asbestos from<br>2,000 ft of pipe x $12 per foot<br>and 400 sq ft equipment x $12 per sq ft | <br>$24,000<br>4,800 | |
| Subtotal Asbestos Removal and Disposal | | 28,800 |
| Solvent Wiping, Removal and Disposal of Electrical Wiring, Controls and Equipment | | |
| Solvent Wiping of Electrical Equipment<br>2,800 sq ft x $2/sq ft | <br>$5,600 | |
| Removal of Electrical Equipment | | |
| 12 Runs conduit 81 ft long x $1.75/ft | 1,700 | |
| 15 Runs conduit 20 ft long x $1.75/ft | 500 | |
| 15 Light fixtures at $40 each | 600 | |
| Overhead crane (Removed by Riggers) | 2,000 | |
| Controls | 2,000 | |
| Motors | 2,000 | |
| Disposal of conduit & light fixtures 100 cu ft x $6/cu ft | 600 | |
| Salvage value wire, controls, motors & crane | 0 | |
| Subtotal Solvent Wiping, Removal & Disposal of Electrical Equipment | | $ 15,000 |
| Removal and Disposal of Explosive Washout Water Sump Sludge | | 10,000 |
| Removal and Disposal of Explosive Washout Water Sump Water | | 5,000 |
| Excavation & Removal of Washout Water Sump | | 10,000 |
| Cold Solvent Washout and Disassembly of Process Equipment (Including disposal of contaminated solvent)* | | 50,000 |
| Solvent wiping of 1,000 sq ft steel siding at $2 per sq ft | | 2,000 |
| Shipment and Disposal by Incineration of Solvent Wet Rags* | | 3,200 |
| Subtotal Pretreatment Cost | | 144,000 |
| Planning, Engineering and Design (10% Pretreatment Cost) | | 14,400 |
| Contingency (10% Pretreatment Cost) | | 14,400 |
| **Pretreatment Cost for Alternatives 4A and 4B** | | **$ 172,800** |
| Additional cost for solvent wiping 2,300 sq ft sheet aluminum | | 5,400 |
| Shipment and Disposal by Incineration of Solvent Wet Rags | | 7,600 |
| **Pretreatment Cost for Alternatives 3, 5A and 5B** | | **$ 185,800** |

* Bethany Purdy, Chemcial Waste Management, Inc. (800) 962-4987, 14 June 93 Telecom

square foot required for the Hydroblasting and Demolition/Disposal Alternatives would add another $5,400 to these remediation alternatives. Solvent wiping of the aluminum siding and roofing would not be required in Alternatives 4A and 4B because the aluminum would be decontaminated in the Hot Gas Process.

The estimated cost for cold solvent washing the interior of the process equipment and piping in the washout and pelletizer building and disassembly of the piping and equipment is $45,000. This includes $5,000 for off-site treatment by incineration of 300 gallons of explosives-contaminated solvent containing approximately 0.5% by weight explosive.

The costs developed for this alternative are considered order-of-magnitude estimates and have an expected accuracy within +50 percent and -30 percent. This range of accuracy is consistent with current EPA guidance for FS reporting(3)

The estimated cost for removal and disposal of the sludge and water from the explosive washout water sump totals approximately $15,000.

***4.2.1.3 Estimated Quantity of Explosives-Contaminated Materials Requiring Remediation.*** The total quantity of building materials and equipment potentially requiring remediation is listed in Table 4-2. This includes all of the structural material from Building 489 and all the equipment currently inside Building 489 plus the explosive washout water concrete sump (which is located about halfway between Building 489 and the Explosive Washout Lagoons), as wells as the metal trough leading to the washout lagoons. Table 4-3 shows a breakdown of the quantity of process equipment to be treated.

***4.2.1.4 Treatment Residuals.*** Five major alternatives and two variations of the major alternatives were considered for remediation of Building 489:

- Alternative 1 - No Action
- Alternative 2- Sump Cleanout/Controlled Access
- Alternative 3 - Hydroblasting, Inspection, Demolition, and Disposal
- Alternative 4A - Hot Gas Decontamination, Demolition, and Disposal
- Alternative 4B - Hot Gas Decontamination, Partial Demolition, and Disposal
- Alternative 5A - Demolition, Inspection, and Disposal of Contaminated Materials
- Alternative 5B - Demolition, Inspection, Concrete Incineration, and Disposal

Alternatives 1 and 2 would produce no treatment residual. Alternatives 4A and 5 (both A and B) would produce the same quantity of building materials and process equipment, but in the case of Alternative 5A, all the concrete, equipment, and trough (totalling 9,650 cubic feet) would have to be disposed of as hazardous waste because no treatment would be performed. Alternative 4B would produce the least treatment residual (except for Alternatives 1 and 2), because only part of the Washout Plant would be demolished in this alternative.

**Table 4-2: Estimated Quantity of Explosive Contaminated Materials in Washout Plant**

| | Surface Area (Sq Ft) | Volume (Cu Ft) |
|---|---|---|
| Concrete (Including Explosive Washout Water Sump) | 8,500 | 5,800 |
| Galvanized Steel Siding** | 1,000* | 240 |
| Aluminum Siding and Roof Panels** | 2,300 | 380 |
| Asbestos Insulation** | 300 | 150* |
| Electric Wiring and Controls (Inside Building)** | 400 | 60 |
| Process Equipment | 3,200 (exterior surfaces) | 3,350 |
| Ladders and Walkways** | 200 | 100 |
| Steel Explosive Washout Water Trough** (Between Building 489 and Washout Lagoons) | 600 | 200 |
| **Approximate Total** | **16,500 sq ft** | **10,480 cu ft** |

* Estimated contaminated portion of 8,300 sq ft total of corrugated galvanized steel siding and roofing and contaminated portion of 300 cu ft total of asbestos insulation on piping and equipment.

** Decontaminated, if necessary, during pretreatment operations.

Sample calculations for estimates of total concrete surface and volume are included in Appendix A.

Source: Arthur D. Little, Inc.

**Table 4-3: Estimated Quantity of Potentially Explosive-Contaminated Process Equipment in Building 489**

| Process Equipment | External Surface Area (sq ft) | Estimated Volume (cu ft) |
|---|---|---|
| Washout Tanks 51 ft x 6 ft x 5.5 ft ht (Total size 3 tanks) | 1,610* | 1,630 |
| Washout Tanks Vent to Roof 3.5 ft diam. x 35 ft | 440 | 440 |
| Heat Exchangers and Pumps 30 ft x 2 ft x 2 ft | 200 | 120 |
| Piping 1000 ft x 2 in (2.5 in O.D.) | 210 | 150 |
| Separation Tank 6 ft ht x 7 ft diam. | 130 | 300 |
| DOPP Kettle 2 ft ht x 7 ft diam. | 50 | 100 |
| Pellet Tower 7 ft ht x 3.5 ft diam. | 80 | 90 |
| Pelletizer Pumps 4 at 8 cu ft each | 30 | 32 |
| Dryer 15 ft x 7 f. x 4 ft | 390 | 420 |
| Overhead Hoist | 60 | 40 |
| **Approximate Total** | **3,200 sq ft** | **3,350 cu ft (130 cu yds)** |

*External surface plus accessible internal surface.

Sample calculations for washout tank surfaces and volumes are included in Appendix A.

Source: Arthur D. Little, Inc.

Alternative 3 would produce a greater *total* volume of treatment residuals, than any other alternative. The treatment residuals would include: the decontaminated structure and equipment materials generated in the other alternatives plus the spent abrasive, concrete dust, and contaminated activated carbon. The volume of hazardous waste generated would also be greater than all the other alternatives except Alternative 4A.

For Alternatives 3, 4A, 4B, 5A and 5B, it is anticipated that the metal components (building structural steel, sheet metal roofing and siding, metal process equipment, electrical wiring and controls) would be decontaminated to meet the preliminary remediation goals (for explosives 2,4,6-TNT, 1,3,5-TNB, HMX, and RDX). The metal components would then be landfilled or utilized as scrap metal in a smelter.

Except for Alternatives 2 and 5A, the concrete floors and blast wall in Building 489 would be decontaminated (before or after demolition) to below the preliminary remediation goals (PRGs). Table 4-4 summarizes the residual levels of explosive contamination proposed for the PRGs. The concrete floors (and blast wall) would be demolished (to rubble) and the rubble landfilled on site at UMDA. Table 4-5 summarizes the remedial action alternatives and the disposal options associated with each alternative.

***4.2.1.5 Monitoring and Review.*** In Alternative 1, high concentrations of explosives would remain in the sump and potentially remain within the process equipment representing both potential health and explosion hazards.

In addition to the RCRA requirements, CERCLA requires that if a remedial action is selected that results in contamination remaining at the site, a review of the action must be conducted no less often than every five years to assure that human health and the environment are being protected (CERCLA Section 121 [c]). For purposes of this FS, it has been assumed that a five year review would be conducted for any remedial alternative selected where the contaminated material was left in place. This review requirement would apply to both Alternatives 1 and 2.

***4.2.1.6 Land Use Restrictions.*** A basic premise guiding remediation at the Explosives Washout Plant is that the site will be released at some time in the future for unrestricted light industrial use.

### 4.2.2 Alternative 1 - No Action

***4.2.2.1 Process Description.*** According to the NCP, the level of treatment achieved must be compared to the required expenditures of time and materials as an integral portion of the remedy selection process. The No Action alternative serves as a common reference point for subsequent analysis and comparison with the other alternatives selected for detailed evaluation.

***4.2.2.2 NCP Criteria Analysis.*** The degree to which the No Action alternative satisfied the seven threshold and primary balancing criteria of the NCP is summarized in Table 4-6 and discussed below.

**Table 4-4**
**Preliminary Remediation Goals for the Explosives Washout Plant (Building 489) Interior Building Surfaces**

**Accessible Surfaces (below 6 feet)**

| Analyte | Carcinogenic PRG (1E-05 Risk Level) (mg/m²) | (μg/cm²) | Noncarcinogenic PRG (Hazard Index of 1) (mg/m²) | (μg/cm²) |
|---|---|---|---|---|
| 135TNB | * | * | 4.63 | 0.46 |
| 246TNT | 128 | 12.8 | 46.3 | 4.63 |
| HMX | * | * | 4,632 | 463 |
| RDX | 35 | 3.5 | 278 | 27.8 |

**Inaccessible Surfaces (above 6 feet)**

| Analyte | Carcinogenic PRG (1E-05 Risk Level) (mg/m²) | (μg/cm²) | Noncarcinogenic PRG (Hazard Index of 1) (mg/m²) | (μg/cm²) |
|---|---|---|---|---|
| 135TNB | * | * | 9.26 | 0.92 |
| 246TNT | 256 | 25.6 | 92.6 | 9.26 |
| HMX | * | * | 9,264 | 926 |
| RDX | 70 | 7 | 556 | 55.6 |

*Not calculated because contaminant is not considered a carcinogen or slope factor is not available.

Source: Dames & Moore[13]

## Table 4-5: Summary of Remediation Alternative Actions (Page 1 of 2)

| Alternative | Remediation Action | Disposal Actions for Alternatives |
|---|---|---|
| 1 | **No action** | No action |
| 2 | **Sump Cleanout/Controlled Access**<br>- Removal and disposal of explosive sludge from washout water sump<br>- Removal and disposal of explosive contaminated water from washout water sump<br>- Flame out and landfill washout water sump debris<br>- Control Access - Lock Washout Plant | - Sludge disposed of by UMDA personnel or subcontractor in ADA burn pit<br>- Contaminated water disposed of by addition to lagoon soil compost piles<br>- Landfill decontaminated washout water sump |
| 3 | **Pretreatment**<br>- Dusting, vacuuming, scraping, and wiping of pigeon droppings<br>- Asbestos removal by certified contractor<br>- Solvent wiping of structural steel, corrugated metal, siding and roofing, electric equipment and process equipment (external)<br>- (Internal) solvent flushing (washing) or process equipment<br>- Removal and disposal of explosive sludge from explosive washout water sump<br>- Removal and disposal of water from explosive washout water sump | - Landfill of pigeon droppings<br>- Disposal offsite in approved landfill<br>- On-site landfill or sale as scrap metals, solvent wet rags would be disposed of by off-site incineration<br>- Waste solvent would be disposal of offsite by incineration<br>- Sludge disposed of by UMDA personnel or subcontractor in ADA burn pans or burn pit<br>- Water disposed of by addition to lagoon soil compost piles |
| | **Hydroblasting (with abrasive additive) of concrete and process equipment exterior** | - Off-site disposal of concrete fines, paint, and abrasive by incineration, stabilization, and landfill |
| | **Inspection and sampling of process equipment internals** | - None |
| | **Demolition** | - None |
| | **Disposal** | - Concrete debris disposed of onsite by landfill. Process equipment landfilled onsite in Active Landfill or offsite in Subclass C landfill |
| 4A | **Pretreatment** (same as Alternative 3) | - Same as pretreatment for Alternative 2, except waste solvent could be burned in Hot Gas System |
| | **Hot Gas Decontamination of concrete and process equipment** | - None |
| | **Demolition of entire washout plant** | - None |
| | **Disposal** | - Metals sold as scrap. Concrete debris landfilled onsite |

Table 4-5: Summary of Remediation Alternative Actions (Page 2 of 2)

| Alternative | Remediation Action | Disposal Actions for Alternatives |
|---|---|---|
| 4B | **Pretreatment** (same as Alternative 3) | - Same as pretreatment for Alternative 3, except waste solvent could be burned in Hot Gas System |
| | **Hot Gas Decontamination** of Concrete and Process Equipment | - None |
| | **Demolition** of Pelletizer Building of Washout Plant | - None |
| | **Disposal** | - Metals sold as scrap. Concrete debris landfilled onsite |
| 5A | **Pretreatment** (same as Alternative 3) | - Same as pretreatment for Alternative 3 |
| | Flame Washout Water Sump | - None |
| | **Demolition** | - None |
| | **Inspection** | - None |
| | **Disposal** | - Concrete debris and process equipment landfilled onsite in Active Landfill or offsite in Subclass C landfill |
| 5B | **Pretreatment** (same as Alternative 3) | - Same as pretreatment for Alternative 3 |
| | **Demolition** | - None |
| | **Inspection** | - None |
| | **Incineration** of concrete rubble | - None |
| | **Disposal** | - Concrete debris landfilled onsite. Process equipment landfilled onsite in Active Landfill or offsite in Subclass C landfill |

**Table 4-6: Summary of NCP Criteria Evaluation for No Action Alternative (Alternative 1)**

| Threshold Criteria | | Primary Balancing Criteria | | | | |
|---|---|---|---|---|---|---|
| **Overall Protection** | **Compliance with ARARs** | **Long-Term Effectiveness** | **Reduction of Toxicity, Mobility, or Volume** | **Short-Term Effectiveness** | **Implementability** | **Cost** |
| Does not enhance protection of human health and environment. There is little current risk from Washout Plant, but there is risk to human health and the environment from the sump contents. | Does not comply with remedial requirements of the NCP or the State of Oregon | Long-term effectiveness not achieved since future human exposure potential and environmental impacts not reduced. | No reduction in mobility or volume. Minimal natural reduction in toxicity. | No near-term activities planned at the site so little exposure to workers. Current access restrictions protect public. | Requires no active implementation. Difficult to justify to regulatory agencies and community. | No immediate costs. However, if the base were closed, at a minimum, institutional controls would be required. |

Source: Arthur D. Little, Inc.

*Overall Protection of Human Health and the Environment.* In addition to the current risk posed by the sludge and contaminated water in the washout water sump, this alternative does nothing to enhance the future protection of adjacent communities, the environment, or land users. The future risks posed by the contamination within the building and sump, which were judged by EPA as sufficient to warrant inclusion of the Explosives Washout Building on the UMDA Remedial Investigation, would remain at the current level.

The No Action alternative would present only a minimal risk of exposure to UMDA personnel during routine site activities. The building is removed from areas of active use, so direct contact with the contamination would not be expected. Exposure via the air pathway would be minimal because the explosives have a low volatility. This alternative would, however, require continued security and maintenance activities to preclude personnel contact with the explosives in the Washout Plant or sump and/or release to the environment.

*Compliance with ARARs.* This alternative would not comply with either state or federal ARARs regarding site remediation. Likewise, the State of Oregon states a preference for cleanup to background or, when background is not feasible, to that lowest level that is protective of human health and the environment and cost-effective. The No Action alternative does not demonstrate a remedial effort that results in protection of human health or the environment.

*Long-Term Effectiveness.* This alternative provides no long-term protection of human health and the environment, and the potential for direct exposure to future site users remains.

*Reduction in Toxicity, Mobility, and Volume.* The No Action alternative achieves no reduction in the toxicity, mobility, or volume of the contaminants present.

*Short-Term Effectiveness.* Since no remedial activities are conducted, there would be no short-term impacts to workers, the public, or the environment.

*Implementability.* There is no technical reason that the No Action alternative could not be implemented. The Explosives Washout Building as it now exists place no constraints on UMDA operations.

However, there are two administrative considerations in implementing this alternative. First, it is highly unlikely that the No Action alternative would be acceptable to the regulatory agencies or generate favorable response from the local communities. Second, existing levels of contamination would place restrictions on future site use, a situation that would be contrary to the potential future use for light industry or residential development following the possible UMDA closure.

*Cost.* The immediate costs for implementing the No Action alterative would be minimal to none. However, the site could pose unacceptable risks to future industrial or residential users if UMDA were closed. In this event, the Army might be required to retain ownership of the site and provide long-term monitoring and management.

### 4.2.3 Alternative 2 – Sump Cleanout/Controlled Access

***4.2.3.1 Process Description.*** In this alternative, the washout water sump would be remediated and access to the Washout Plant (and remediated sump) controlled.

The contaminated water in the washout water sump would be removed and added to the compost piles being used to treat the washout lagoon soil (which has previously been exposed to the washout water coming from the sump and Washout Plant). The sludge in the sump (containing 40 to 70 percent explosives) would be removed from the sump and (air) dried in the ADA burn trays (pans), and then burned. The use of the burn trays at UMDA is permitted by the EPA until the end of 1994.

The soil around the sump would then be (hand) excavated and the sump lifted, by crane, onto a flat bed truck for transport to an area within UMDA (not yet determined) where it would be flamed, using a remote operated flaming system, to destroy any residual explosive on the surfaces of the sump. The decontaminated sump would then be landfilled on site at UMDA. If the soil around or under the sump was found to be contaminated with explosive, this soil would be treated under the Washout Lagoon soil operable unit.

Since the accessible surfaces of the Washout Plant already meet the PRGs (Table 4-4), there would be no remediation of the Washout Plant itself, but access to the Washout Plant would be controlled by the securing (locking) the building.

By controlling access to the Washout Plant, access to the process equipment in the Washout Plant is also controlled. In addition, access to the internal contamination of the process equipment is limited by the fact that the contamination is inside the equipment. In either case, the contamination inside the process equipment is considered an explosion or deflagation safety hazard by the Army, rather than an environmental issue.

In order to continue to control access to the Washout Plant, maintenance of the building for an indefinite period will be required, perhaps up to 30 years, or until some other disposition is made of the UMDA facility.

***4.2.3.2 NCP Criteria Analysis.*** The degree to which this Sump Cleanout/Controlled Access alternative meets the two threshold and five balancing NCP criteria is summarized in Table 4-7 and discussed below.

**Table 4-7: Summary of NCP Criteria Evaluation for Sump Cleanout/Controlled Access Alternative (Alternative 2)**

| Threshold Criteria | | Primary Balancing Criteria | | | | |
|---|---|---|---|---|---|---|
| **Overall Protection** | **Compliance with ARARs** | **Long-Term Effectiveness** | **Reduction of Toxicity, Mobility, or Volume** | **Short-Term Effectiveness** | **Implementability** | **Cost** |
| This alternative will provide protection of human health and the environment as long as access to the site is controlled and the building is maintained. | Will comply with ARARs. | Would be effective as long as access was controlled and buildings were maintained. | Toxicity of sump sludge and water eliminated – no change in Washout Plant toxicity, mobility, or volume. | Current access restrictions protect public. | Easily implemented. | Total net present value (cost) over 30 years about $220,000. |

Source: Arthur D. Little, Inc.

*Overall Protection of Human Health and the Environment.* The current risk to human health and the environment is caused by the potential for human exposure to the contaminated water or the sludge in the washout water sump or release to the environment of the explosive contaminated water. Because of existing access restrictions, there is very little current risk to humans or the environment from the Washout Plant. Once the sump is decontaminated and moved to the Washout Plant, carcinogenic and non-carcinogenic risks will be within EPA guidelines.

*Compliance with ARARs.* The State of Oregon states a preference for cleanup to background level where feasible or the lowest level that is protective of human health and the environment. This alternative may not meet that preference for the Washout Plant depending on the regulations. If it assumed that controlled access is protective of human health and the environment and cleanup to background is not feasible because of the high cost of other alternatives, then this ARAR would be met. The alternative would meet the Preliminary Remediation Goals listed in Table 4-4. As long as access to the Washout Plant is controlled, the risk-based (human) exposure criteria will be met and the other ARARs evaluated for the NCP criteria appear to be met or are not applicable.

*Long-Term Effectiveness.* As long as access is controlled, this alternative should provide long-term effectiveness.

*Reduction in Toxicity, Mobility, and Volume.* The Sump Cleanout/Controlled Access Alternative eliminates the toxicity associated with the explosive sludge and washout water in the washout sump, but it does not reduce the toxicity, mobility, or contaminated materials in the Washout Plant.

*Short-Term Effectiveness.* Except for any hazards in handling the washout water sump (and its contents) there would be no short-term impacts to workers, the public, or the environment.

*Implementability.* This alternative should be more easily implemented than any of the other alternatives (except "No Action").

*Cost.* The initial (capital) cost for this alternative should be about $55,000 and the longer term cost about $8,000 per year for 30 years. This would result in a Net Present Value (total cost) of about $220,000 (Table 4-8).

### 4.2.4 Alternative 3 - Hydroblasting

Hydroblasting is a proven technology for cleaning surfaces. It has been used for decontaminating military vehicles and nuclear facilities. It has been used commercially to clean buildings, railroad cars, large heat exchangers, reactors, etc.[9] Off the shelf equipment is available from a number of manufacturers and distributors. It can be used to clean any hard surface such as steel or concrete, but not “soft” surfaces such as wood or fiberboard. It would work well for cleaning the external surfaces of the process equipment and could be used to remove up to a depth of 2 cm from the concrete surface. It would not be effective for cleaning explosives that had penetrated to a depth below 2 cm into the concrete masonry floors or blast wall because of the interference of the aggregate in the concrete.

**Table 4-8: Alternative 2 Cost**
**Sump Cleanout/Controlled Access for UMDA Explosive Washout Plant Building 489**

*Basis:* *Remove 4,500 gal washout water and 500 gal.(67 cu ft) sludge from Washout Water Sump, flame sump, and landfill decontaminatied sump. Maintain Washout Plant building.*

| | | |
|---|---|---|
| **Equipment Capital Cost** | | |
| (To prevent pigeon access) Repair roof on pelletization building and screen all building openings | | $ 10,000 |
| **Operating Cost for Partial Remediation (Sump Cleanout)** | | |
| Removal and Disposal of Sump (Explosive) Sludge at UMDA (Allow) | $10,000 | |
| Removal and Disposal of Sump Washout Water at UMDA (Allow) | 5,000 | |
| Excavate, flame out, and landfill decontaminated sump | 24,500 | |
| Cut up and move washout water metal trough pieces into Bldg. 489 | 500 | |
| Subtotal Partial Remediation | | 40,000 |
| **Equipment and Partial Remediation** | | 50,000 |
| 10% Contingency | | 5,000 |
| **Total Initial Cost** | | **55,000** |
| **Annual Operating Costs** | | |
| Building & Fence Maintenance 0.06 x $130,000 = $7,800 per year | | 76,000 |
| **Remedial Action Design and Planning** | | 90,000 |
| **Net Present Value (Initial and Annual Costs for 30 years)** | | **$221,000** |

Source: Arthur D. Little, Inc.

The wastewater generated by the hydroblasting of the masonry (floors and blast wall) and equipment exterior would have to be treated and disposed of on site. The waste solids generated by the hydroblasting would be disposed of off site.

***4.2.4.1 Process Description.*** Hydroblasting is the use of high pressure water jet (generally up to 50,000 psi) to remove surface material, or in the case of concrete, up to 2 cm of depth of the surface. The high pressure jet is directed against the surfaces to be decontaminated and the debris and water collected. The water is treated (usually by filtration) and recycled to the high pressure water jet. Abrasive grit is sometimes added (as it would be for this site) to the high pressure water jet to improve surface penetration.

The main advantages of hydroblasting over grit blasting (which was eliminated in the preliminary screening) are that hydroblasting would generate less fugitive dust emissions and there is less of an explosion hazard. The hydroblasting system would consist of the following:

- High pressure hose and gun (hand held)
- High pressure pump
- Clean water supply tank and pump
- Contaminated water collection sump and settling tank
- Contaminated water treatment system
- Transfer pumps

The contaminated water treatment system in this application would include only a settling tank and a leaf filter for normal operation. An activated carbon water treatment system would be added after hydroblasting operations are finished for treatment of the hydroblast water prior to disposal on site. The contaminated carbon would be sent off site for incineration. Alternatively, the hydroblast water could be disposed of by adding it to the Washout Lagoon soil compost piles. The concrete dust and spent grit from hydroblasting would be treated offsite by incineration and the incinerator ash would be landfilled in a hazardous waste landfill (because of the metals in the hydroblasted paint). The (hydroblasted) process equipment would be tested for residual internal contamination (after an internal solvent washing) and removed from the building for on-site disposal by landfill or off-site disposal in a Subtitle C landfill. The cost for disposal of the process equipment in this alternative (and in Alternatives 5A and 5B) was based on disposal in a Subtitle C (off-site) landfill. Although this appears to be an option from an EPA regulatory standpoint up until at least May 1994, from the Army safety standpoint, it may be more desirable to ship the contaminated equipment to another Government facility such as a Government owned or operated explosives production plant where it can be decontaminated by oven heating. The cost for this latter option was not estimated. If the process equipment was decontaminated at another Government facility, the process equipment could then be reused or disposed of as scrap metal. Concrete rubble from demolition of the building (after hydroblasting) would be disposed of in an on-site landfill.

#### 4.2.4.2 Operating Parameters (Requirements).

*Site Suitability.* This site (Building 489) would be quite suitable for hydroblasting operations because the building itself will provide secondary containment for the hydroblasting operations. The existing floor trough should be adequate for the collection of hydroblast water (and solids), but additional settling capacity, beyond that provided by the trough sump, and a filtration system would be required for solids removal prior to hydroblast water recycle.

*Utilities.* Hydroblasting has a relatively high power requirement to generate the high water pressures required. It also has a moderate water requirement for initial system filling and makeup water. For example, a hydroblasting unit with a capacity of 10 sqft/hr, to 2 cm in depth, would require a pump developing a pressure of 10,000 psi at 11 gpm. The motor drive would be about 80 HP or 66 KW (140A at 480V) for this pump. Water requirements would be about 25,000 gal for initial filling plus makeup of 10,000 gal for 60 days operation.

*Personnel.* Hydroblasting is a very labor intensive operation taking approximately one hour to hydroblast 10 square feet. We have assumed that for safety reasons, two workers would be required full-time during each 8-hour shift of hydroblasting operations (one operating the hydroblaster and one helper/alternate hydroblaster).

*System Performance.* The performance of the hydroblasting system in surface removal efficiency has been well established through experience. What is unknown, however, is the depth of contamination in the concrete. It has been assumed for this FS, for all treatment alternatives, that penetration of explosive contamination into any of the concrete surfaces does not exceed 2 cm.

*Implementation Time.* Implementation time for installation of the hydroblasting system (after pretreatment operations have been carried out) is minimal, probably less than a month after the wastewater treatment equipment arrives on site. The remedial treatment time, however, is relatively long at 60 days of 16 hrs/day operation (2 shifts/day) or 120 days of 8 hours per day operation (1 shift/day).

***4.2.4.3 NCP Criteria Analysis.*** The seven screening criteria discussed in Section 4.1 are evaluated below and summarized in Table 4-9.

*Overall Protection of Human Health and Environment.* This alternative would provide for protection of human health and the environment at the building site by totally removing the contaminants from the UMDA site. Occupational risks to on-site workers are expected to be minimized through the use of specific operating controls and procedures and appropriate training. Occupational risks would be addressed in the Project Health and Safety Plan.

*Compliance with ARARs.* Hydroblasting would be expected to meet all ARARs, as described below.

*Chemical-Specific ARARs.* Hydroblasting would be expected to successfully reduce explosives concentrations on the surface of the concrete and equipment to below detection levels. Assuming that non-detection is the reasonable equivalent of background, this would meet the State of Oregon's preference for cleanup to background concentrations.

**Table 4-9: Summary of NCP Criteria Evaluation for Hydroblasting Building 489 Concrete and Equipment (Alternative 3)**

| Threshold Criteria | | Primary Balancing Criteria | | | | |
|---|---|---|---|---|---|---|
| **Overall Protection** | **Compliance with ARARs** | **Long-Term Effectiveness** | **Reduction of Toxicity, Mobility, or Volume** | **Short-Term Effectiveness** | **Implementability** | **Cost** |
| Protection of human health is (at the site) achieved by the removal and treatment of the contamination therefore reducing the excess cancer risk. Prevention of risk to the environment offsite, would be achieved by incinerating the hydroblast sludges and spent carbon. | For the site, this alternative would comply with all ARARs except, possibly, the preference shown in AMCCOM Regulation No. 385-5 for thermal treatment prior to release of materials to the general public. | Effectiveness would be permanent for the site. | This alternative would reduce the volume and mobility of the contaminated materials. Toxicity would also be reduced by incinerating the hydroblasting sludge and spent carbon. | Building should contain any potential emissions of hydroblast slurry and protective clothing should protect operators. | This alternative could be readily implemented using commercially available equipment. | The total estimated capital and operating costs for this alternative is about $890,000. |

Source: Arthur D. Little, Inc.

*Location-Specific ARARs.* Hydroblasting would not be expected to affect protected species present at the UMDA facility, nor affect any off-site designated wetlands if the hydroblasting residues are properly treated and disposed of.

*Action-Specific ARARS.* Provided that the proposed hydroblasting system for UMDA is operated in accordance with operational guidelines, the atmospheric dispersion of the hydroblasting slurry droplets at UMDA would be contained within the building and would not present a threat to downwind receptors.

The spent abrasive, the concrete dust, and the spent activated carbon would be considered potentially reactive wastes and would be incinerated off site in accordance with RCRA 40 CFR 268.42. The ash from the incineration would then be disposed of in a hazardous waste landfill. The process equipment (which has had its exterior hydroblasted but may still have internal contamination) is not considered a RCRA waste, but would not meet AMCCOM Regulation No. 385-5 preference for thermal treatment prior to release to the general public.

*Long-Term Effectiveness and Permanence.* Hydroblasting provides for the permanent and irreversible removal of contaminants from the UMDA site, and thus the on-site hydroblasting system evaluated here is expected to provide long-term protection of human health and the environment at this site. Final explosives concentrations on the surface of the concrete and equipment would be expected to meet PRGs. There would be no permanent disturbance of land areas as part of the remedial project, and the building area would be restored to surrounding conditions following remediation. Because the removal of contaminants is essentially to background concentrations, the treated building and equipment would not require long-term management. Evaluation of the soil beneath the Explosive Washout Plant would continue as part of the UMDA installation-wide RI/FS.

*Reduction of Toxicity, Mobility or Volume through Treatment.* Hydroblasting itself would not reduce the toxicity of the explosive contaminants in the sludge residues generated by the hydroblasting operations. However, off-site incineration and landfill of this sludge would reduce its toxicity, mobility and volume. The concentration of the explosives in the solid residuals from the exterior of the equipment and surface of the concrete would be below 10% explosives and, therefore, not reactive. The hydroblasting of the equipment and concrete, therefore, does serve to significantly reduce the volume of contaminated waste (600 cu ft of hydroblast sludge plus 100 cu ft carbon from wastewater treatment) from that which would be generated from demolition and disposal of the concrete rubble (a total of 5,800 cu ft).

*Short-Term Effectiveness.* This alternative could be implemented and completed relatively quickly (within about four months after completion of building pretreatment) since it is a proven technology and the equipment required should be readily available.

Short-term impacts to the community, workers, and the environment are expected to be minimal. Access to the UMDA facility is currently restricted and would remain so throughout the remediation; therefore, the primary risks associated with hydroblasting would be exposure to the surrounding public and environment from hydroblasting aerosol emissions, which should be completely contained within the building. No protected species or sensitive land areas are expected to be affected during remediation.

Land areas disturbed to accommodate hydroblasting operations would be restored following project completion.

Protection of workers during hydroblasting would require the use of personal protective equipment.

Transportation of hazardous materials would be a minor issue because, although the hydroblasting sludge and spent activated carbon from wastewater treatment are to be treated off site, the volume is relatively small (700 cu ft = 26 cu yds) and the contaminants (explosives) are adsorbed on a solid (non-mobile) medium. Transportation would become even less of an issue if the hydroblast residues were treated ons ite by one of the technologies proposed for treatment for the other contaminated media at UMDA (soil and ground water) and only the spent activated carbon (100 cu ft = 3.7 cu yds) were disposed of off site.

*Implementability.* The general technical feasibility of hydroblasting building structures and equipment has been demonstrated at several sites, including Frankfort Arsenal, Luminous Processes Inc. (Athens, Ga.) and One Market Plaza Office Complex (San Francisco, Calif.)[9]. The hydroblasting system is a very simple system to operate. If the auxiliary water treatment system is properly set up and operated, there should be minimal downtime and it should be possible to perform necessary repairs and maintenance during the non-operational period of time.

With respect to the specific application of hydroblasting to the UMDA Explosives Washout Plant, it would be feasible to assemble the hydroblasting equipment in the project area. No obstacles have been identified in terms of obtaining all normal legal approvals, such as site access authorization and local construction permits. Site access would be granted by UMDA for all required activities. Construction permits would not be required, but all construction would have to meet Army specifications. Federal, state, and local permits would not be required for this on-site action in accordance with CERCLA Section 121(e) and the Federal Facility Agreement (FFA), but the system would meet all substantive regulatory requirements with respect to air emissions, water discharges, and solids disposal. Public reaction will be assessed during the public review of the Proposed Plan, and addressed in the development of a ROD.

Availability of all the equipment required for this process is good, as this technology is currently seeing widespread use for the treatment of surface contamination.

*Cost.* Table 4-10 presents the estimated capital and operating costs for treatment of the concrete and exterior process equipment surfaces by Hydroblasting. Costs were developed based on the process descriptions presented earlier. Costs for the hydroblasting operations are summarized by cost category in Table 4-10; the elements of the individual costs categories are discussed below. Table 4-11 summarizes the complete costs for Alternative 3 including pretreatment, demolition, and disposal. The costs developed for this alternative are considered order-of-magnitude estimates and have an expected accuracy within +50 percent and -30 percent. This range of accuracy is consistent with current EPA guidance for FS reporting[3]

**Table 4-10: Hydroblasting Cost Analysis for UMDA Explosive Washout Plant Building 489**

***Basis: 8100 square feet concrete, 900 square feet Process Equipment Exterior Surfaces***

**Capital Cost**

| | |
|---|---|
| Hydroblaster (11 gpm @ 10,000 psi)* 80 HP | $ 33,100 |
| Pipe and tank cleaning equipment* | 8,400 |
| Two transfer pumps (11 gpm @ 50 psi) | 2,100 |
| Two storage tanks (12,000 gallons each, carbon steel) | 40,000 |
| Water filter system (pump and two plate filters) | 10,000 |
| Activated carbon system (3.5 gpm for final hydroblast water treatment) | 27,000 |
| Modification of UMDA trough sump | 2,400 |
| Miscellaneous valves, piping, hoses | 4,000 |
| Subtotal Hydroblasting Installed Equipment Capital Cost | 127,000 |
| Planning, Engineering and Design (10% Installed Cost) | 12,700 |
| Contingency (10% Installed Cost) | 12,700 |
| **Hydroblasting Capital Cost** | **$152,400** |

**Operating Costs**

**Labor**

| | |
|---|---|
| Initial setup of tanks and pumps (mobilization) 4 people x 40 hours = | 160 |
| Daily takedown/setup of hydroblaster 56 days x 2 ph/day = | 112 |
| Hydroblasting concrete - 8,100 square feet/10 square feet per hour x 2 people = | 1,620 |
| Hydroblasting equipment - 900 square feet/20 square feet per hour x 2 people = | 90 |
| Scaffolding setup for blast wall = | 80 |
| Daily cleanup - 2 person hours/day x 56 days = | 112 |
| Final cleanup/demobilization = | 70 |
| Operating Labor (Unskilled Labor) | 2,244 (person hrs.) |

| | |
|---|---|
| Operating labor cost @ $18/hr x 2,244 person hours = | $ 40,300 |
| Overhead and supervision (at 150% labor)** = | 60,600 |
| Level C protective gear = | 2,400 |
| Activated carbon (purchase) - 3,000 lbs x $1.25/lb = (for treating hydroblast water) | 3,800 |
| Power (85 kw x 900 hours x $0.07/kwh = | 4,600 |
| Equipment maintenance - 0.06 x $127,000 x 4 mos/12 mos = | 2,500 |
| Analysis of hydroblast sludge and treated bldg/equip. surfaces = | 30,000 |
| Subtotal Operating Cost | 144,200 |
| Contingency (10% Subtotal Operating Cost) | 14,400 |
| **Hydroblasting Operating Cost** | **$158,600** |

*EPA "Guide for Decontaminating Buildings, Structures, and Equipment at Superfund Sites" EPA/600/2-85/028 (March 1985)[9]
**Includes fringe benefits, other payroll overhead, plant overhead, and supervision.

Source: Arthur D. Little, Inc.

**Table 4-11: Alternative 3 Cost**
**Pretreatment, Hydroblasting, Inspection, Demolition and Disposal**

| | | | |
|---|---|---|---|
| **Washout plant pretreatment Operations**[1] | | | |
| (See Table 4-1, Pretreatment Costs) | | | $185,800 |
| **Hydroblasting operations** | | | |
| (See Table 4-10, Hydroblasting Cost Analysis) | | | |
| Capital Cost | | | 152,400 |
| Operating Cost | | | 158,500 |
| **Tank and Equipment Inspection Cost**[2] | | | 20,000 |
| (Explosive analysis costs included in Operating Cost) | | | |
| **Demolition Costs**[3] | | | |
| Equipment disassembly | (Included in Pretreatment) | | |
| Electrical equipment | (Included in Pretreatment) | | |
| Steel siding & roof | 8,300 sq ft x $0.80/sq ft = | 6,700 | |
| Aluminum siding & roof | 2,300 sq ft x $0.80/sq ft = | 1,800 | |
| Building steel frame | 640 ft x $4.70/ft = | 3,000 | |
| Ladders & overhead walkways | 120 ft x $9.50/ft = | 1,100 | |
| Concrete floors and sump | 3,900 cu ft x $13/cu ft = | 50,700 | |
| Concrete wall | 1,900 cu ft x $21/cu ft = | 39,900 | |
| Miscellaneous @ 25% | = | 25,800 | |
| | Subtotal Demoliton Cost | | 129,000 |
| **Disposal Costs** | | | |
| Concrete fines & abrasive (with paint and explosive)[4] | | | |
| 600 cu ft x $35/cu ft = | | 21,000 | |
| Spent activated carbon (with explosive)[5] | | | |
| 100 cu ft x $70/cu ft = | | 7,000 | |
| (Decontaminated) concrete rubble | | | |
| 200 cu yds x $7/cu yd = | | 1,400 | |
| (Decontaminated) Metal siding & framing | | | |
| 100 cu yds x $6/cu yd = | | 600 | |
| Process equipment (Subtitle C Landfill)[6] | | | |
| 135 cu yds x $200/cu yd = | | 27,000 | |
| Miscellaneous @ 25% | | 14,200 | |
| | Subtotal Disposal Cost | | 71,200 |
| **Remedial Action Design & Planning** | | | 170,000 |
| **Total Cost for Alternative 3** | | | **$887,000** |

1 Includes solvent wiping of aluminum sheeting and roof.
2 Includes cutting out false bottoms on Washout Tanks to facilitate inspection and extensive sampling.
3 Means Heavy Construction Cost Data[12]
4 Assuming incineration, fixation, and landfill offsite.
5 Assuming incineration offsite.
6 Budget quotation from Chemical Waste Management, Inc., Arlington, Oregon.

Source: Arthur D. Little, Inc.

In these estimates, it was assumed that the concrete dust, abrasive residues, and the spent activated carbon would be treated off site by incineration and landfilled. The 25,000 gallons of wastewater generated by the hydroblasting operation would be treated on site (over a period of five days) to reduce the volume of waste to 100 cu ft. of spent carbon and reduce its potential for mobility in case of an accident during transportation off site. The cost for shipping and treating the hydroblast wastewater off site would be nearly equivalent to treating the wastewater on site with activated carbon and shipping the activated carbon offsite for disposal.

*Mobilization/Demobilization.* The mobilization (one week) would include setup and checkout of the hydroblast and water treatment systems. The demobilization (one week) would include wastewater activated carbon treatment and site cleanup. Mobilization cost is included as part of the operating labor cost.

***4.2.4.4 Summary.*** A compilation of the NCP criteria evaluation was provided in Table 4-9. Based on the evaluation, hydroblasting appears to be an effective and feasible technique for remediating the building concrete and process equipment exterior surfaces. The total estimated capital and operating costs for this alternative is approximately $890,000.

### 4.2.5 Alternative 4 - Hot Gas Decontamination

The hot gas decontamination process has been demonstrated and shown to be effective for the removal of 2,4,6-TNT from concrete (both surface and internal) to below detectable levels at Cornhusker AAP[4] and the removal of 2,4,6-TNT, ammonium picrate, and smokeless powder from equipment to below detectable levels at Hawthorne AAP.[5]

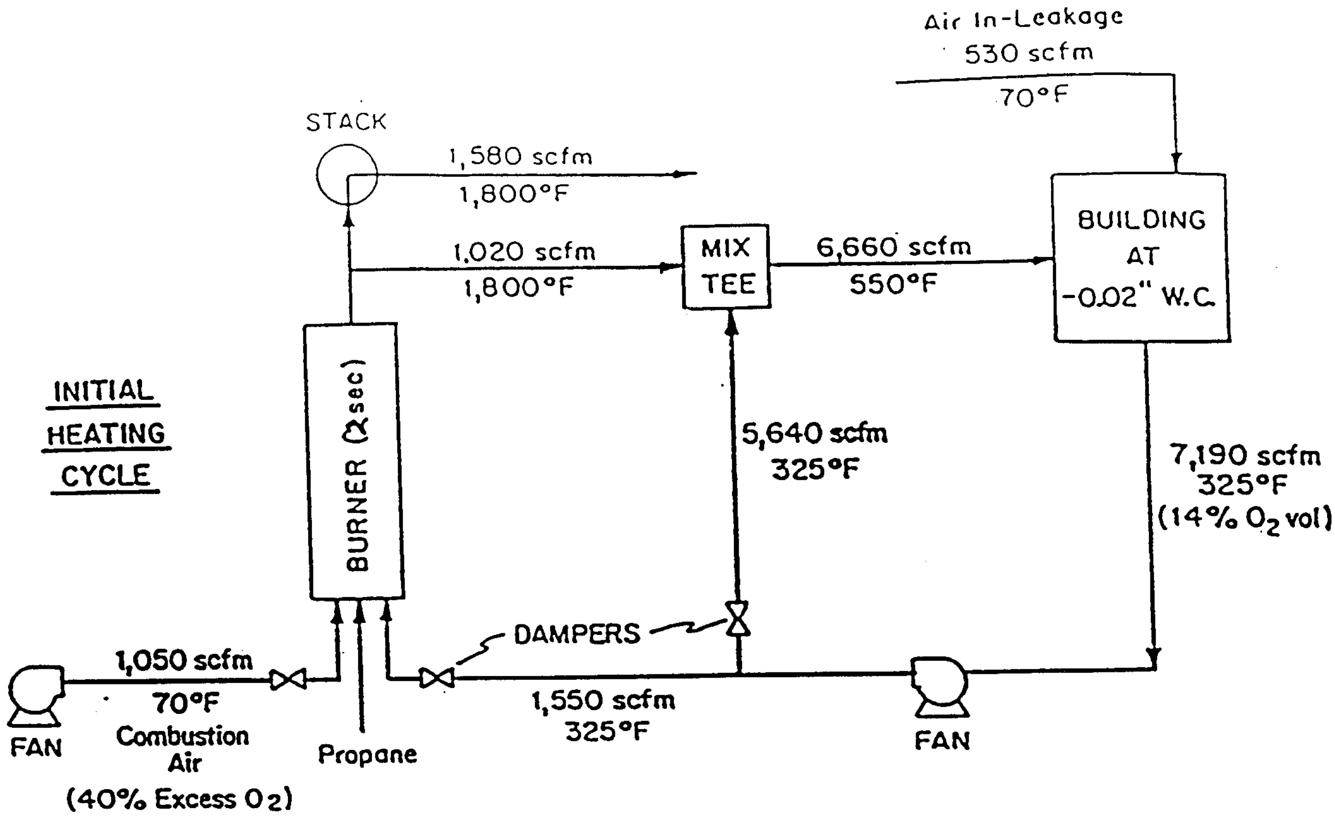
***4.2.5.1 Process Description.*** In the hot gas decontamination process, hot gas is used to vaporize and desorb the explosive contaminants from the non-porous surface of equipment and/or from the surface or subsurface of porous materials such as concrete. The hot gas from the building, or equipment enclosure, then passes through an afterburner where the contaminants removed from the building or equipment are destroyed. The hot gas supplied to the building, or equipment enclosure, would either be generated by a separate burner or by recycling hot gas from the afterburner and building. Figure 4-2 shows a flow diagram for the proposed system.

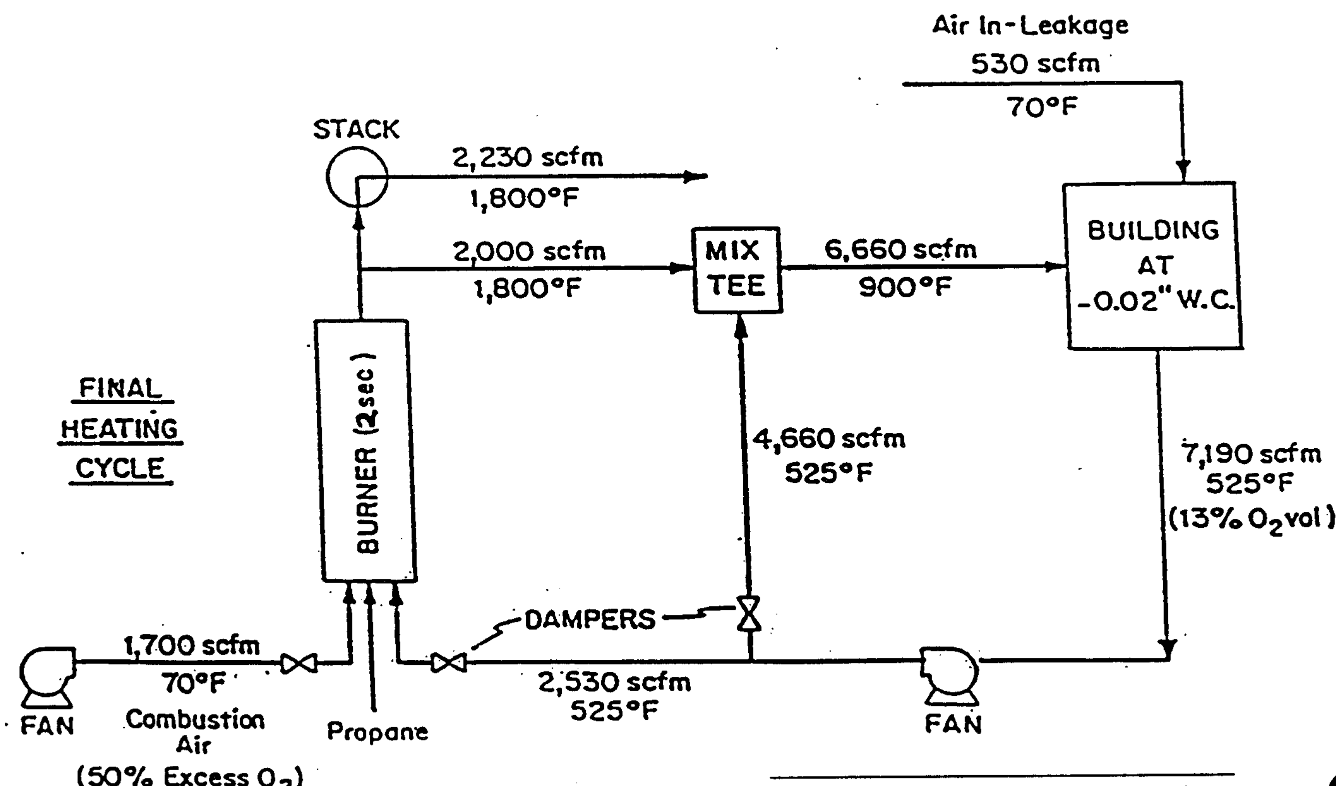
The system basically consists of three main components:

- Hot gas supply to the building or equipment enclosure
- An enclosure consisting of an air barrier and insulation installed around the building area or equipment to be decontaminated
- An afterburner to destroy contaminants in the hot gases exiting the building

Insulated ductwork is used to connect these three main components. Fans and dampers are used for air and gas flow control through the building, ductwork and afterburner.

**Figure 4-2**
**Small Building Area Hot Gas Decontamination System Flow Diagram**




scfm = standard cubic feet of air per minute

Source: Arthur D. Little, Inc.

A system could be constructed to treat almost any size building in one operation, but usually the most economical approach is to use a smaller system and divide the building into several segments for treatment. Each segment is compartmentalized to form an air tight, insulated section. Ductwork is run to this segment from the hot gas source and to the afterburner from the building segment. After each segment is decontaminated, the air barrier, insulation (panels), and ductwork are disassembled and moved to the next area to be treated.

The afterburner is started up first. Once an operating temperature of 1,800 to 1,900° F is reached (retention time in the afterburner is 2 seconds), the flow of hot gas is started to the building or equipment enclosure. All the hot gas leaving the system passes through the afterburner. The temperature of the hot gas to the building is initially controlled at 450 to 550° F and gradually increased at a rate of about 50° F/hr until the maximum temperature of about 800° F is reached. For each building segment the heat up time is about 20 hours, and the time at maximum temperature about 4 hours. This is followed by a 24-hour cool down period.

The afterburner acts as the air pollution control system, effectively destroying the contaminants. Particulate emissions from the system during previous demonstration runs were less than 0.0002 gr/scfd(4) which is well under the RCRA requirement of 0.08 gr/scfd (40 CFR 264.343).

At UMDA, both Alternatives 4A and 4B would thermally remediate the process equipment and building materials, the difference between the two alternatives is the extent of demolition of the two process buildings. In Alternative 4A, both the pelletizing and washout buildings would be demolished and disposed of in a landfill, and in Alternative 4B, the pelletizing building would be demolished and the washout building would be kept for future use. In order to determine whether or not significant quantities of explosive remain beneath the floor of the washout building (as the result of the demolition and reconstruction of the washout building on the same site in the 1950s), concrete core and soil samples (to a depth of one foot in the soil) would be taken beneath the washout water overflow trough in the Washout Plant under Alternative 4B.

#### *4.2.5.2 Operating Parameters (Requirements).*

*Site Suitability.* Since this building is contaminated with explosives (TNT and RDX), there is potential for explosion during remediation, particularly when a thermal process is used for decontamination. The configuration of this building is such (with a blast wall down the center) that the control panel and operating personnel can safely be positioned on the side of the blast wall opposite the section of building being decontaminated and located far enough away from the buildings for safety. There is also more than ample space for the control system trailer and the necessary propane tanks at this site.

*Area Requirements.* The space required for this system (outside the building itself) includes a 15 by 30-foot area for a control trailer (a converted small mobile home) and a somewhat larger area for four propane (fuel) storage tanks and a vaporizer. The area required for the propane storage tanks and vaporizer would be approximately 40 by 40 feet.

*Utilities.* Electric power requirements for a hot gas system handling 7,200 scfm of gas (air and flue gas) at 1,900° F in the afterburner would be approximately 45 KW. Of this,

*Utilities.* Electric power requirements for a hot gas system handling 7,200 scfm of gas (air and flue gas) at 1,900° F in the afterburner would be approximately 45 KW. Of this, about 37KW (45HP) would be for the fan motors and about 8KW for operation of the instrument and control systems. Maximum propane requirements during afterburner startup would be 700 lbs/hour (about 12 lbs/minute). This would drop to about 7 lbs/minute with the hot gas recycle to the building. No compressed air or water (except for fire protection) would be required.

*Personnel.* Two to four personnel would be required for installing the insulated enclosure (sheet metal and insulation) around the section of building to be treated and the ductwork to and from the enclosure. Six operators plus any stack sampling personnel would be required during each of the 24-hour decontamination runs (two persons per shift for three shifts).

*Performance Testing.* Although this process has been tested with TNT on concrete and TNT, ammonium picrate and smokeless powder on equipment, it has not been tested for several of the explosives and explosive decomposition products present in Building 489. In addition, the previous tests with this system have been with a less energy efficient process where the hot gases were passed once through the system, rather than recirculating a portion of the hot gases to increase energy (fuel) efficiency. Fuel is the largest component of operating cost. Recycle of the hot gas from the afterburner would reduce fuel cost by one third to one half the fuel costs of the "once through" system previously tested.

For the reasons stated above, a demonstration test of this process is recommended before implementation of this alternative. The demonstration test would also serve as a performance test or trial burn, and the system used for the demonstration test could also be sized to allow its use for completing the decontamination of the building and equipment under remedial Alternatives 4A and 4B. For these reasons, a demonstration test has been included in our operating cost estimate of the system.

*Implementation Time.* Because of the requirement for initial construction of the incineration system (6 to 9 months) and demonstration testing (2 to 3 months), implementation time would be expected to be 8 to 12 months. The actual decontamination process by this alternative following the demonstration testing should take 2 months or less.

***4.2.5.3 NCP Criteria Analysis.*** The seven screening criteria discussed in Section 4.1 are evaluated below and summarized in Table 4-12 for the Hot Gas Decontamination Process:

*Overall Protection of Human Health and Environment.* Alternatives 4A and 4B would provide for overall protection of human health and the environment and meet the remedial action objectives set by EPA by destroying essentially all of the contaminants of concern. The concentrations of the explosives in the treated building materials and equipment would be reduced to final concentrations below detection limits.

Short-term protection of public health and the environment during remediation would be achieved directly by using specific design and operating controls to minimize emissions and discharges. Indirect protection would also be afforded by the distance from the proposed hot gas system to populated areas.

**Table 4-12: Summary of NCP Criteria Evaluation for Hot Gas Decontamination of Building 489 Concrete and Equipment (Alternatives 4A and 4B)**

| Threshold Criteria | | Primary Balancing Criteria | | | | |
|---|---|---|---|---|---|---|
| **Overall Protection** | **Compliance with ARARs** | **Long-Term Effectiveness** | **Reduction of Toxicity, Mobility, or Volume** | **Short-Term Effectiveness** | **Implementability** | **Cost** |
| Protection of human health is achieved by the removal and treatment of the contamination, therefore reducing the excess cancer risk and by treatment and monitoring of afterburner stack gas emissions. | Accomplished with >99.99% DRE of explosives. Meets AMCCOM Regulation 385-5 preference for thermal treatment prior to release to the general public. | Effectiveness would be permanent and long term, since contaminants are destroyed with a 99.99% efficiency. No long-term management required. | Destruction of contaminants reduces toxicity associated with explosives to essentially background levels. Stack emissions expected to be very low toxicity. Treated building materials and equipment not expected to be hazardous. | Workers, environment, and community protected during operations by using proper safety procedures and process monitoring. Time to implement and complete remediation (including demonstration test) is estimated at 10 to 14 months. | Construction of a custom built system would be required. A similar system has been constructed and operated, however, at CAAP and HWAAP. It is estimated that the time required for design, construction, and demonstration testing of this system would be 8 to 12 months. | Capital cost is about $408,000. The total capital and operating cost for Alternative 4A (with total demolition of the Washout Plant) would be approximately $1,2000,000 and the total cost for Alternative 4B (with demolition of only the Pelletizer Building) would be approximately $1,100,000. |

Source: Arthur D. Little, Inc.

Occupational risks to on-site workers are expected to be minimized through the use of specific operating controls and procedures and appropriate training. Occupational risks would be addressed in the project Health and Safety Plan for these alternatives.

*Compliance with ARARs.* Hot gas decontamination would be expected to meet all ARARs, as described below.

*Chemical-Specific ARARs.* Hot gas decontamination would be expected to successfully reduce explosives concentrations in building materials and process equipment to below detection levels. Assuming that nondetection is the reasonable equivalent of background, this would meet the State of Oregon's preference for cleanup to background concentrations when feasible.

*Location-Specific ARARs.* Hot gas decontamination would not be expected to affect protected species present at the UMDA facility, nor affect any off-site designated wetlands.

*Action-Specific ARARs.* Hot gas decontamination met all federal and state regulations for the treatment of building materials and equipment at the Cornhusker and the Hawthorne AAP sites, respectively. The preference for remediating the building and equipment to detection limits for each contaminant was achieved at both of those sites, where explosives concentrations on the building and equipment surfaces were higher than concentrations measured at UMDA. It is, therefore, anticipated that all state and federal regulations will be met for the UMDA site. Provided that the proposed combustion units for UMDA are run in accordance with operational guidelines, the atmospheric dispersion of the stack gases at UMDA would not present a threat to down wind receptors. Hydrogen chloride emissions are not a concern, since chlorine is not a constituent of any of the site contaminants. Instrumentation would be provided to monitor the required stack gas parameters. Hot gas decontamination would also meet the AMCCOM Regulation 385-5 preference for thermal decontamination prior to the release of the equipment and building materials to the public.

*Long-Term Effectiveness and Permanence.* Hot gas decontamination provides for the permanent and irreversible destruction of contaminants, and thus the on-site hot gas decontamination system evaluated here could be expected to provide long-term protection of human health and the environment. Final concentrations of each of the explosives in the building materials and process equipment would be expected to be below 2µg/g or 0.02µg per sq cm. There would be no permanent disturbance of land areas as part of the remedial project.

Because the destruction of contaminants is essentially to background levels, the treated materials would not require long-term management. Evaluation of contaminated soil around and below the Explosive Washout Plant (Bldg. 489) would continue as part of the UMDA installation-wide RI/FS and the Washout Lagoon soil remediation.

*Reduction of Toxicity, Mobility, or Volume Through Treatment.* Hot gas decontamination achieves permanent and irreversible reductions in the concentrations of and thus toxicity of the contaminants of concern. Only a limited volume (about 2,200 scfm for 40 days operation) of stack gas would be exhausted to the atmosphere,

and these emissions are expected to have no adverse impacts because of the low concentration of residual explosive (peaking at less than one part per trillion volume or 10 μg per cu.m. over 3 hours of each 24-hour decontamination run).

**Short-Term Effectiveness.** This alternative could be implemented and completed relatively quickly, as discussed in the Section 4.2.5.2, once the demonstration test was completed. It is assumed that about one year would be required to design, procure and test a hot gas system. Following that, operations would require six to eight weeks for remediation of the building. Short-term impacts to the community, workers, and the environment are expected to be minimal. Access to the UMDA facility is currently restricted and would remain so throughout the remediation; therefore, the primary risks associated with hot gas decontamination system would be exposure to the surrounding public and environment from off-gas emissions. Previous applications have demonstrated greater than 99.99 percent destruction efficiency, thus eliminating measurable risks to human health and the environment posed by air-entrained organics. Further, the decontamination enclosure is maintained at slightly negative pressure to avoid leakage of hot gases. Protection of the community would be achieved by the described design and by close monitoring of operation and stack gas parameters. In addition, the hot gas decontamination system would be shut down in the event of an upset.

No personal protective equipment, except that used in normal construction activities, would be required by the operators except dust masks during the installation of the insulation around the hot gas containment module. A key element of operational safety would be the placement of the control trailer and propane fuel tanks. No protected species or sensitive land areas are expected to be affected during remediation.

Transportation of hazardous materials is not an issue because the building materials would be decontaminated in-situ before being disposed of on site and the metal materials would be disposed of (off site) as scrap metal.

**Implementability.** The general technical and administrative feasibility of the hot gas decontamination process has been demonstrated at other military installations, such as the Hawthorne and Cornhusker AAPs.

Because the only moving parts of this system are valves, dampers and fans, the hot gas decontamination system has a relatively low rate of maintenance. The estimated downtime for maintenance is 5 to 10%. The primary technical concerns associated with this particular application of hot gas decontamination are explosives safety with regard to prior solvent washing of the interior of the process equipment and location of the control system and propane fuel tanks in relation to the treated building area.

With respect to the specific application of hot gas decontamination at the UMDA Explosives Washout Plant, it would be feasible to assemble the equipment in the project area. No obstacles have been identified in terms of obtaining all normal legal approvals, such as site access authorization and local construction permits. Site access would be granted by UMDA for all required activities. Construction permits would not be required, but all construction would have to meet Army specifications. Special precautions would be taken in design and operation to isolate the hot gas afterburner and propane vaporizer as potential ignition sources from other materials stored at the UMDA facility. Federal, state, and local permits would not be required for this on-site action in

accordance with CERCLA Section 121(e) and the FFA, but the system would meet all substantive regulatory requirements with respect to air emissions, water discharges, and solids disposal. Public reaction will be assessed during the public review of the Proposed Plan, and addressed in the development of the ROD.

*Cost.* Table 4-13 presents the estimated capital and operating costs for the hot gas decontamination treatment of the concrete and both the interior and exterior of the process equipment. The cost of a demonstration test has been included in the operating cost estimates.

The capital cost was estimated for a hot gas decontamination system having a single burner (afterburner) system with a maximum gross rating of about 14 million Btu/hr. In this energy efficient design, hot gases from the afterburner and the hot gas containment module would be recycled to the containment module (section of the building being decontaminated). An area of concrete measuring about 30 by 40 feet or a volume of process equipment of up to about 8000 cu ft would be decontaminated in each of the seven runs required to remediate the concrete and process equipment in the building. Hot gas flow from the contaminated area would be about 7,000 scfm with 500 to 2500 scfm discharging through the stack and the balance recycled. (See Figure 4-2 for additional operating conditions.)

Between runs, the (decontaminated) area of the building enclosed by the hot gas containment module would be allowed to cool to about 120°F, the module disassembled and then reassembled to enclose the next section of the building to be treated.

It should be noted that while the hot gas decontamination process has a high initial cost (capital cost), its operating cost would be similar to that for other alternatives such as hydroblasting. Also, the size of the system proposed for Building 489 at UMDA would make it useful for decontaminating other buildings at UMDA or buildings (or equipment) at other military installations.

Total operating and capital costs for Alternatives 4A and 4B, Hot Gas Decontamination with total building demolition and Hot Gas Decontamination with partial building demolition (demolition of only the pelletizer building) respectively, are presented in Tables 4-14 and 4-15. Under Alternative 4B, the washout building of the Washout Plant would be retained for future use by the Army. In a variation of Alternative 4B, only the process equipment (not the building) would be decontaminated by the hot gas process. The costs would still be the same for pretreatment, capital investment, and planning, but the operating cost could be reduced by about $30,000; the demolition cost by $28,000; and disposal cost by about $3,000; for a total reduction in cost of about $61,000. The total cost for this variation of alternative 4B would then be about $1,060,000.

The costs developed for this alternative are considered order-of-magnitude estimates and have an expected accuracy within +50 percent and -30 percent. This range of accuracy is consistent with current EPA guidance for FS reporting[3]

***4.2.5.4 Summary.*** A compilation of the NCP criteria evaluation was provided in Table 4-12. Based on the evaluation, hot gas decontamination appears to be an effective and feasible technique for remediating the building concrete and process equipment.

## Table 4-13: Hot Gas Decontamination Cost Analysis for UMDA Explosive Washout Plant Building 489

*Basis: 6600 scfm Hot Gas System with Hot Gas Recycle*

| | | |
|---|---|---|
| **Capital Cost** | | |
| Burner system with controls, fans, dampers | | $170,000 |
| Ductwork and 20 ft. stack | | 30,000 |
| Installation of propane fuel system | | 15,000 |
| Connection to power supply | | 3,000 |
| Installation of burner system and ductwork (materials & labor) | | 62,000 |
| Fabrication of hot gas containment module (materials & labor) | | 75,000 |
| Subtotal Installed Equipment Cost | | $355,000 |
| Planning, Engineering and Design (10% Installed Equipment Cost) | | 35,500 |
| Contingency (5% Installed Equipment Cost) | | 17,750 |
| **Capital Cost** | | **408,250** |
| **Operating Costs[1]** | | |
| Labor | | |
| Relocation of Hot Gas Contaminent Module | | |
| 64 ph/run x 7 runs = | 448ph | |
| Operation of Hot Gas Decontamination System | | |
| 2 operators x 24 hours/run x 7 runs = | 336ph | |
| Operating Labor | 784 (person hours) | |
| Operating labor cost 784 person hours x $25/person hours = | | $19,600 |
| Overhead and supervision (at 150% labor) = | | 29,400 |
| Power (45 kw x 7 runs x 24 hrs/run x $0.06/kwh) = | | 450 |
| Fuel - Propane (2 gal/min x 60 min/hr x 24 hrs/run x 7 runs x $0.50/gal) = | | 10,050 |
| Stack gas sampling and analysis (labor & materials)(1) = | | 30,000 |
| Chemical analysis of treated building materials = | | 30,000 |
| Hot gas system startup and checkout (primarily labor) = | | 65,000 |
| Site operations plan = | | 30,000 |
| Demobilization = | | 20,000 |
| Hot Gas Decontamination Operating Cost [1] | | $ 234,500 |
| Hot Gas Decontamination Demonstration Test [2] | | 105,000 |
| Contingency (5% of Operating Cost and Demo. Test) | | 17,000 |
| **Hot Gas Decontamination Operating Cost [3]** | | **$ 356,500** |

1 Operating costs include costs to perform a compliance test.

2 Cost, in addition to compliance test, to perform a Demonstration Test of the Hot Gas Decontamination System.

3 A lower percent of contingency was added to the Hot Gas Decontamination Process operating cost because the Demonstration Test should resolve most of the uncertainties regarding operation of the system.

Source: Arthur D. Little, Inc.

**Table 4-14: Alternative 4A Cost**
**Pretreatment, Hot Gas Decontamination, Total Demolition and Disposal**

| | | | |
|---|---|---|---|
| **Washout Plant Pretreatment Operations**[1] | | | |
| (See Table 4-1, Pretreatment Costs) | | | $172,800 |
| **Hot Gas Decontamination Operations** | | | |
| (See Table 4-13, Hot Gas Decontamination Cost Analysis) | | | |
| Capital Cost | | | 408,250 |
| Operating Cost | | | 356,500 |
| **Tank and Equipment Inspection Cost**[2] | | | |
| (Explosive analysis cost included in Operation Costs) | | | 1,000 |
| **Demolition Cost** | | | |
| Equipment disassembly | (Included in Pretreatment) | | |
| Electrical equipment | (Included in Pretreatment) | | |
| Steel siding & roof | 8,300 sq ft x $0.80/sq ft = | 6,700 | |
| Aluminum siding & roof | 2,300 sq ft x $0.80/sq ft = | 1,800 | |
| Building steel frame | 640 ft x $4.70/ft = | 3,000 | |
| Ladders & overhead walkways | 120 ft x $9.50/ft = | 1,100 | |
| Concrete floors and sump | 3,900 cu ft x $13/cu ft = | 50,700 | |
| Concrete wall | 1,900 cu ft x $21/cu ft = | 39,900 | |
| Miscellaneous @ 25% | = | 25,800 | |
| | Subtotal Demolition Cost | | 129,000 |
| **Disposal Cost** | | | |
| Decontaminated concrete rubble | 215 cu yds x $7/cu yd = | $1,500 | |
| Decontaminated metal siding & structural steel (freight cost) | | 650 | |
| Decontaminated process equipment (freight cost) | | 1,000 | |
| Miscellaneous @ 25% | | 800 | |
| | Subtotal Disposal Cost | | 3,950 |
| **Remedial Action Design & Planning** | | | 150,000 |
| **Total Cost for Alternative 4A** | | | **$1,221,500** |

1 Does not include solvent wiping of aluminum sheeting or roof, since these materials will be decontaminated by the hot gas process.

2 Includes only limited (spot) sampling of internal surface.

Source: Arthur D. Little, Inc.

**Table 4-15: Alternative 4B Cost**
**Pretreatment, Hot Gas Decontamination, Partial Demolition, and Disposal**

| | | | |
|---|---|---|---|
| **Washout Plant Pretreatment Operations** [1] | | | |
| (See Table 4-1, Pretreatment Costs) | | | $172,000 |
| **Hot Gas Decontamination Operations** | | | |
| (See Table 4-13, Hot Gas Decontamination Cost Analysis) | | | |
| Capital Cost | | | 408,250 |
| Operating Cost | | | 356,500 |
| **Tank and Equipment Inspection Cost** [(2)] | | | |
| (Explosive analysis cost included in Operation Costs) | | | 1,000 |
| **Demolition Cost** | | | |
| Equipment disassembly | (Included in Pretreatment) | | |
| Electrical equipment | (Included in Pretreatment) | | |
| Pelletizer building aluminum siding & roof | 2,300 sq ft x $0.80/sq ft = $ | 1,800 | |
| Pelletizer building floors and sump concrete | 1,700 cu ft x $13/cu ft = | 22,100 | |
| Concrete/soil core samples | (6 cores and analysis) | 3,900 | |
| | Subtotal Demolition Cost | | 27,800 |
| **Disposal Cost** | | | |
| Decontaminated concrete rubble | 56 cu yds x $7/cu yd = | $ 390 | |
| Decontaminated metal siding & structural steel | (freight cost) | 460 | |
| Decontaminated process equipment | (freight cost) | 1,000 | |
| Miscellaneous @ 25% | | 500 | |
| | Subtotal Disposal Cost | | 2,350 |
| **Remedial Action Design & Planning** | | | 150,000 |
| **Total Cost for Alternative 4B** | | | **$1,118,700** |

1 Does not include solvent wiping of aluminum sheeting or roof.
2 Includes only limited (spot) sampling of internal surfaces.

Source: Arthur D. Little, Inc.

The total estimated (initial) capital cost (excluding the Demonstration Test) is approximately $408,000. The cost for remediation Alternative 4A (with total demolition of the Washout Plant and a Demonstration Test) is estimated at approximately $1,200,000, and for Alternative 4B (with a Demonstration Test and demolition of only the Pelletizer Building) the total cost is estimated at approximately $1,100,000. The total cost for the variation of Alternative 4B in which only the process equipment, not the building, were decontaminated using the hot gas process would be about $1 million.

### 4.2.6 Alternatives 5A and 5B: Demolition and Disposal of Contaminated Debris

Demolition is a widely used technology for all types of non-contaminated buildings and structures as a means of clearing a site for an alternative use. In Alternative 5A, the building would be demolished after pretreatment including (internal) cold solvent washing of the process equipment, but without decontamination of the building concrete or exterior surfaces of the equipment.

Alternative 5B would be the same as Alternative 5A, except that the concrete rubble from the demolition of the building would be incinerated to remove any residual explosive contamination; thus allowing the concrete rubble to be landfilled on site at UMDA.

***4.2.6.1 Process Description.*** The building would have to be contained during demolition and the workers would be required to wear Level C protective clothing. The demolition would be performed using standard demolition equipment. The order in which the stages of demolition are carried out and methods used are important in ensuring there are no releases to the environment or risks to the demolition crew.

Pretreatment operations for removal of pigeon droppings, asbestos, and electrical equipment would be carried out first with the building intact. Internal solvent washing of the process equipment would be carried out next to eliminate the potential explosion hazard from residual explosive residue contained within the process equipment, and the equipment partially disassembled to ensure that there were no longer residual pockets of explosive. Following this internal decontamination of the process equipment by solvent washing, the equipment would be tested for residual explosive and removed from the building for disposal by landfill on site or off site in a Subtitle C landfill. (The exterior of the process equipment will still be contaminated, and there may still be a low level of internal contamination.) Another option for disposal of the process equipment for Alternatives 5A and 5B would be oven treatment and disposal as scrap metal (refer to Section 4.2.4.1 of this FS).

The sheet metal siding, roof, walkways, and metal framing would be cleaned, as necessary, by solvent wiping (as a continuation of the pretreatment operation), and then disposed of (off site) as metal scrap, leaving the concrete floors and blast wall remaining for demolition. The blast wall would be thoroughly wetted to reduce dusting and then demolished using a wrecking ball. Since it is not known if pockets of explosives are present in the soil beneath the building (slab on-grade) floors (or wastewater sump), the floors (and wastewater trough sump) would then be broken into pieces for disposal by blasting using water wetting and blast mats as a means to contain debris and dust. Any large pockets of residual explosive present during the blasting would either be detonated by sympathetic explosion or exposed for subsequent handling or removal.

All the concrete rubble (and reinforcing bar) would be water wetted (by spraying) and, in Alternative 5A, landfilled on site or transported off site for disposal in a Subtitle C secure landfill. In Alternative 5B, the concrete rubble would be incinerated in a rotary kiln and landfilled, on site, at UMDA.

***4.2.6.2 Operating Parameters (Requirements).***

**Site Suitability.** After sealing the cracks and joints in the apron and installing a berm, it should be possible to utilize the concrete apron adjoining Building 489 as a staging area for the contaminated equipment and building materials being sent to disposal as hazardous waste. No additional space requirements on site are anticipated. The isolated location of Building 489 would make it suitable for this process alternative.

**Utilities**. The only utilities required for this alternative might be electric power for operation of an air compressor or power hand tools for the building demolition. This requirement should be less than about 50A at 240 V. Other power equipment used for the building demolition would probably be gas or diesel fueled.

**Personnel**. A crew of four to six laborers (and one foreman) is normally required for building demolition. The hauling and disposal of the contaminated equipment and building would be performed under contract with a licensed disposal contractor.

**System Performance**. This alternative will effectively remove all of the (building and equipment) contamination from the site.

**Implementation**. Implementation time for Alternative 5A is minimal, probably less than 2 months after the demolition equipment arrives onsite (assuming pretreatment operations have been completed). Because of the set-up and testing requirements for the incinerator, Alternative 5B would require 6-9 months for implementation.

**4.2.6.3 NCP Criteria Analysis.**

The degree to which this alternative meets the seven screening criteria discussed in Section 4.1 is discussed below and summarized in Table 4-16.

*Overall Protection of Human Health and Environment.* This alternative would provide for protection of human health and environment at the building site itself by totally removing the contaminants. However, the ultimate disposal will either be in an on-site (at UMDA) or off-site landfill where engineering controls will be needed to ensure that human health and the environment are protected. Occupational risks to on-site workers are expected to be minimized through the use of specific operating controls and procedures and appropriate training. Occupational risks would be addressed in the Project Health and Safety Plan.

*Compliance with ARARS.* Demolition and disposal of contaminated debris would be expected to meet all ARARs as described below.

*Chemical-Specific ARARs.* Total removal of the contaminated equipment and building by demolition and (off-site) disposal would eliminate Building 489 as a potential source of contamination.

**Table 4-16:** **Summary of NCP Criteria Evaluation for Demolition/Disposal of Contaminated Building and Process Equipment (Alternatives 5A and 5B)**

| Threshold Criteria | | Primary Balancing Criteria | | | | |
|---|---|---|---|---|---|---|
| **Overall Protection** | **Compliance with ARARs** | **Long-Term Effectiveness** | **Reduction of Toxicity, Mobility, or Volume** | **Short-Term Effectiveness** | **Implementability** | **Cost** |
| Protection of human health is achieved by removal of the contamination from the site, therefore reducing the reduction of excess cancer risk. Prevention of risk to the environment offsite would require proper disposal of the contaminated equipment and debris. | For the site, this alternative would comply with all ARARs except the preference shown in AMCCOM Regulations 385-5 for thermal treatment of materials prior to release to the general public. | Effectiveness would be permanent for the site. Although an off-site TSD facility or on-site landfill will have been designed to permanently store the wastes, the explosives contamination is not destroyed and the Army would still remain liable for the wastes. | This alternative would not reduce the volume or toxicity of the contaminated materials. Mobility of the explosives in the contaminated materials would be reduced by landfill disposal. | Emissions of contaminated concrete dust would have to be controlled by water spraying of concrete during demolition and transport. | This alternative could be readily implemented using commercially available equipment. | There is little or no capital cost estimated for these alternatives The operating costs estimated for Alternative 5A is approximately $820,000 (no treatment of debris) and about $1,200,000 for Alternative 5B (with incineration of concrete debris). |

Source: Arthur D. Little, Inc.



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*Location-Specific ARARs.* Demolition and disposal (off site) of the contaminated debris would not be expected to affect protected species present at the UMDA facility, nor affect any off-site designated wetlands if the contaminated residues are properly treated and disposed of.

*Action-Specific ARARs.* Provided that the proposed demolition and disposal of debris is carried out in accordance with operational guidelines, the atmospheric dispersion of any dust from the demolition at UMDA would not present a threat to downwind receptors. Water sprays may be used to reduce dust emissions. However, the alternative would not meet the preference for thermal treatment presented in AMCCOM Regulation 385-5.

*Long-Term Effectiveness and Permanence.* Demolition and off-site disposal of the contaminated debris provides for the permanent and irreversible removal of contaminants at the site, and thus the demolition and disposal alternative evaluated here is expected to provide long-term protection of human health and the environment at this site. However, the ultimate disposal will be in a landfill at UMDA or off-site landfill where engineering controls will be needed to ensure that human health and the environment are protected.

There would be no permanent disturbance of land areas as part of the remedial project, and the building area would be restored to surrounding conditions following remediation. Because the removal of contaminants is essentially to background, the treated building and equipment would not require long-term management. Evaluation of the soil beneath the Explosive Washout Plant would continue as part of the UMDA installation-wide RI/FS.

*Reduction of Toxicity, Mobility or Volume Through Treatment.* Demolition and disposal of the contaminated equipment and debris would not reduce the toxicity or volume of the explosive contaminants in Alternative 5A. The total volume of contaminated equipment and concrete currently in Building 489 is estimated at about 9,650 cu ft and this would not be reduced by transferring it to a landfill. Mobility would, however, be reduced by engineering controls at the landfill.

In Alternative 5B, the toxicity, mobility, and volume of contaminated concrete would be reduced, but neither toxicity nor volume would be reduced for the contaminated process equipment.

*Short-Term Effectiveness.* This alternative could be implemented and completed relatively quickly (within about two months after completion of building pretreatment), since it is a proven technology and the equipment required should be readily available.

Short-term impacts to the community, workers, and the environment are expected to be minimal. Access to the UMDA facility is currently restricted and would remain so throughout the remediation project; therefore, the primary risks associated with the demolition activity would be exposure to workers to detonable quantities of explosive and/or exposure of the surrounding public and environment to dust generated during demolition.

Protection of workers during demolition would require the use of personal protective equipment. No protected species or sensitive land areas are expected to be affected during remediation. Land areas disturbed to accommodate demolition or incineration operations would be restored following project completion.

*Implementability.* Demolition has been widely practiced in the construction industry for non-contaminated buildings and structures. More recently, the combination of demolition and disposal of contaminated structures is being practiced at (former commercial) Superfund sites, and the equipment required for this alternative is widely available from the construction industry.

**Cost.** Table 4-17 presents the estimated costs for Alternative 5A, Demolition and Disposal of the contaminated building and equipment (without decontamination).

Costs are summarized by cost category in Table 4-17. The elements of the individual cost categories are discussed below.

In these estimates, it was assumed that it would not be necessary to purchase capital equipment, but all the equipment for demolition and disposal (off site) would be supplied by a commercial contractor. The demolition cost for an explosive contaminated building was assumed to be twice that for a non-contaminated building because of the loss in productivity in having to work in protective clothing. It was also assumed that the contaminated process equipment and debris would either be disposed of on site or off site (at the same cost) in a secure RCRA-approved landfill.

The estimated costs for Alternative 5B, Demolition, Concrete Incineration and Disposal of contaminated and decontaminated materials are shown in Table 4-18. The costs developed for this alternative are considered order-of-magnitude estimates and have an expected accuracy within +50 percent and -30 percent. This range of accuracy is consistent with current EPA guidance for FS reporting.[3]

***4.2.6.4 Summary.*** A compilation of the NCP criteria evaluation was provided in Table 4-16. Based on the evaluation, this alternative does appear to be technically feasible and effective for cleaning up the Washout Plant site. There could, however, be a regulatory problem in disposing of the explosive contaminated wastes. While it is anticipated that there would be little or no capital cost requirement, the cost for Alternative 5A is estimated at about $820,000, and for Alternative 5B, about $1,200,000.

### 4.3 Comparative Analysis of Alternatives

All of the alternatives evaluated in this FS (except Alternative 1) meet the CERCLA Threshold Evaluation Criteria (Overall Protection of Human Health and the Environment, and Compliance with ARARs) and the Primary Balancing Criteria of Short-Term Effectiveness and Implementability. The ability of each of the alternatives to meet the remaining Balancing Criteria of Long-Term Effectiveness and Permanence; Reduction of Toxicity, Mobility, and Volume; and Cost will differ with each of the alternatives.

**Table 4-17: Alternative 5A Cost Demolition, and Disposal Cost for Contaminated UMDA Explosive Washout Plant Building 489 Materials and Equipment**

Basis: 5,800 cu ft concrete; 3,550 cu ft process equipment

**Capital Cost**

There would be no capital cost for this alternative, since both the demolition and disposal would be contracted to a commercial company.

| | | | |
|---|---|---|---|
| **Washout Plant Pretreatment Operations**[1] (See Table 4-1, Pretreatment Costs) | | | $185,800 |
| **Demolition Operations** | | | |
| Equipment disassembly | (Included in Pretreatment) | | |
| Electrical equipment | (Included in Pretreatment) | | |
| Steel siding & roof | 8,300 sq ft x $0.80/sq ft = | $6,700 | |
| Aluminum siding & roof | 2,300 sq ft x $0.80/sq ft = | 1,800 | |
| Building steel frame | 640 ft x $4.70/ft = | 3,000 | |
| Ladders & overhead walkways | 120 ft x $9.50/ft = | 1,100 | |
| Concrete floors and sump[2] | 3,900 cu ft x $26/cu ft. = | 101,500 | |
| Concrete wall[2] | 1,900 cu ft x $42/cu ft = | 79,900 | |
| Miscellaneous @ 25% | = | 48,500 | |
| Demolition Cost for unremediated building | | 242,500 | |
| 10% Contingency | | 24,300 | |
| Subtotal Demolition Operations | | | 266,800 |
| **Tank and Equipment Inspection Cost**[3] | | | 20,000 |
| **(Remote) Flaming of Empty Washout Water Sump** | | | 8,000 |
| **Disposal Cost** | | | |
| Contaminated concrete rubble[4] (Subtitle C landfill) | 215 cu yds x $250/cu yd = | $53,800 | |
| Contaminated process equipment[4] (Subtitle C landfill) | 135 cu yds x $200/cu yd = | 27,000 | |
| Decontaminated steel framing & metal siding | 100 cu yds x $6/cu yd = | 600 | |
| Miscellaneous materials at 25% | = | 20,400 | |
| Subtotal Disposal | | | 101,800 |
| **Remedial Action Design & Planning** | | | 240,000 |
| **Total Cost for Alternative 5A** | | | **$822,400** |

1 Includes solvent wiping the aluminum sheeting and the roof.

2 A productivity factor of 0.5 was used for contaminated concrete demolition because of safety and protective clothing requirements.

3 Includes cutting out false bottoms on Washout Tanks to facilitiate inspection and extensive sampling.

4 Budget quote from Chemical Waste Management, Inc.

Source: Arthur D. Little, Inc.

**Table 4-18: Alternative 5B Cost**
**Demolition, Incineration of Concrete Rubble and Disposal of Washout Plant Building 489 Materials and Equipment**

Basis: 5,800 cu ft concrete, 3,550 cu ft process equipment

**Capital Cost**

There would be no capital cost for this alternative, since the demolition, concrete rubble incineration, and disposal would be contracted to a commercial company.

| | | | |
|---|---|---|---|
| **Washout Plant Pretreatment Operations(1)** (See Table 4-1, Pretreatment Costs) | | | $185,800 |
| **Demolition Operations** | | | |
| Equipment disassembly | (Included in Pretreatment) | | |
| Electrical equipment | (Included in Pretreatment) | | |
| Steel siding & roof | 8,300 sq ft x $0.80/sq ft = | $6,700 | |
| Aluminum siding & roof | 2,300 sq ft x $0.80/sq ft = | 1,800 | |
| Building steel frame | 640 ft x $4.70/ft = | 3,000 | |
| Ladders & overhead walkways | 120 ft x $9.50/ft = | 1,100 | |
| Concrete floors and sump(2) | 3,900 cu ft x $26/cu ft.= | 101,500 | |
| Concrete wall(2) | 1,900 cu ft. x $42/cu ft = | 79,900 | |
| Miscellaneous @ 25% | = | 48,500 | |
| Demolition Cost for unremediated building | | 242,500 | |
| 10% Contingency | | 24,300 | |
| Subtotal Demolition Operations | | | 266,800 |
| **Tank and Equipment Inspection Cost(3)** | | | 20,000 |
| **Incineration of Concrete Rubble** | | | |
| Capital Cost | | | |
| Site preparation | | $ 18,000 | |
| Mobilization/Demobilization | | 100,000 | |
| Trial Burn | | 100,000 | |
| Operating cost | | | |
| 421 tons (215 cu yds) x $550/ton = | | 231,400 | |
| Subtotal Incineration of Concrete Rubble | | $ 449,400 | |
| 10% Contingency | | 45,000 | |
| | | | 494,400 |

(Table 4-18, Alternative 5B continued on next page)

**Table 4-18: Alternative 5B Cost (continued)**
**Demolition, Incineration of Concrete Rubble, and Disposal of Washout Plant Building 489 Materials and Equipment**

| | | | |
|---|---|---|---|
| **Disposal Cost** | | | |
| Decontaminated concrete rubble | 215 cu yds x $7/cu yd = | 1,500 | |
| Contaminated process equipment[4] | 135 cu yds x $200/cu yd = | 27,000 | |
| Decontaminated steel framing & metal siding | 100 cu yds x $6/cu yd = | 600 | |
| Miscellaneous materials at 25% | | 7,300 | |
| | Subtotal Disposal | | 36,400 |
| **Remedial Action Design & Planning** | | | 180,000 |
| **Total Cost for Alternative 5B** | | | **$1,183,400** |

1 Includes solvent wiping of aluminum sheeting and roofing.

2 A productivity factor of 0.5 was used for the contaminated concrete demolition because of safety and protective clothing requirements.

3 Includes cutting out false bottoms on washout tanks to facilitate inspection and extensive sampling.

4 Budget quote from Chemical Waste Management, Inc.

Source: Arthur D. Little, Inc.

The degree to which these three Balancing Criteria (Long-Term Effectiveness and Permanence, Reduction of Toxicity Mobility, and Volume and Cost) can be achieved is dependent both on the decontamination alternative and the method of disposal. These latter two factors (decontamination and disposal methods) may, in turn, be affected by Army regulations. For example, if the criteria used for allowing on-site or off-site landfill of concrete debris were a negative wipe test with Webster's or Greiss Reagent, then all of the alternatives (except 1, 2, and, perhaps 5A) would met this criteria. Likewise, if the reagent wipe test were used as the criteria for determining the presence of explosives, the metal process equipment and piping could meet the criteria for all the alternatives (except 1 and 2) allowing it to be landfilled on site or off site or, perhaps, be melted down as scrap (under Government control).

Table 4-19 presents a summary of the degree to which each of the alternatives meets the seven EPA Evaluation Criteria. Figure 4-3 presents a ranking of the remediation alternatives based on the degree to which each alternative meets each of the criteria. A description of how the rankings were assigned follows:

**Overall Protection of Human Health and the Environment.** There is, currently, no risk to the environment and minimal risk to human health due to the Washout Plant because of the containment of the explosive contamination within the building and limited access to the building. In contrast, the washout water sump poses both an environmental and human health hazard, making Alternative 1 unacceptable. All of the remaining alternatives (2, 3, 4A, 4B, 5A, and 5B) would be protective of human health and the environment, both in regard to the Washout Plant and the associated washout water sump. Alternatives 4A and 4B would, however, provide the greatest protection of human health and the environment.

**Compliance with Applicable or Relevant and Appropriate Requirements (ARARs).** All of the alternatives are considered to comply with the ARARs. The measured explosives concentrations in the Washout Plant are already below the cleanup goals. The State of Oregon's requirement is to clean up to background where feasible and cost-effective, and if not, then to attain risk-based cleanup standards. Background for explosives in the Washout Plant is essentially zero, or below detection limits. Only Alternatives 4A, 4B, and 5B could be expected to destroy all the explosives in the Washout Plant. Compliance with Army safety requirements is assured by all the alternatives except Alternative 1.

*Long-Term Effectiveness and Permanence.* Of all the alternatives, the greatest long-term effectiveness is offered by Alternatives 4A and 4B. All of the remaining alternatives, except Alternative 1 (which has no long-term effectiveness), have adequate long-term effectiveness and permanence. Alternative 2 would have slightly less long-term effectiveness and permanence than other remediation alternatives (Alternatives 3 through 5B) because of the potential residual contamination within the process equipment, but the major current risk, the washout water sump, would be remediated in this alternative as well as in all the other remediation alternatives.

**Reduction of Toxicity, Mobility or Volume through Treatment**
Alternatives 4A and 4B would reduce toxicity, mobility, and volume of contaminants to the greatest extent. Alternatives 2, 3, 5A, and 5B would not reduce toxicity in regard to

**Table 4-19: Summary of Comparison Factors for Remedial Alternatives for UMDA Explosive Washout Plant (Page 1 of 2)**

| Remediation Alternative | Overall Protection | Compliance with ARARS | Long-Term Effectiveness & Permanence |
|---|---|---|---|
| Alternative 1<br>No Action | Does not enhance protection of human health and environment. There are no current risks to human health or the environment from the Washout Plant, but there are risks from the washout water sump. | Does not comply with remedial requirements of NCP or the State of Oregon. | Long-term effectiveness not achieved since future human exposure potential and environmental impacts not reduced. |
| Alternative 2<br>Sump Cleanout/ Controlled Access | This alternative will provide protection of human health and the environment as long as access to the site is controlled and the building is maintained. | Meets all ARARS. | Would be effective as long as access was controlled and buildings maintained. Not quite as effective as other remediation alternatives because of potential for residual explosive in process equipment. |
| Alternative 3<br>Pretreatment, Hydroblasting, Inspection, Demolition, and Disposal | This alternative will provide protection of human health (and the environment) onsite. Protection of the environment offsite would be achieved by incineration of the hydroblast sludges and carbon. | This alternative would comply with all ARARs except the preference shown in AMCCOM Regulations 385-5 for thermal treatment of materials prior to release to the general public. | Effectiveness would be permanent for the site. |
| Alternative 4A&4B<br>Pretreatment, Hot Gas Decontamination, Total demolition (4A) or Partial Demolition (4B) and Disposal | This alternative will provide protection of human health and the environment by complete destruction of the contaminants. | Accomplished with >99.99 percent destruction of explosives. Meets AMCCOM Regulations 385-5 preference for thermal treatment prior to the release to the general public. | Effectiveness is permanent both on site and off site. No long-term management is required. |
| Alternative 5A & 5B<br>Pretreatment, demolition, Inspection (Concrete Incineration for Alternative 5B only) and Disposal | This alternative will provide protection of human health and the environment. | This alternative would comply with all ARARs except the preference shown in AMCCOM Regulations 385-5 for thermal treatment of materials prior to release to the general public. | Effectiveness would be permanent for the site. |

**Table 4-19: Summary of Comparison Factors for Remedial Alternatives for UMDA Explosive Washout Plant (Page 2 of 2)**

| | Reduction of Toxicity, Mobility, or Volume | Short-Term Effectiveness | Implementability | Cost |
|---|---|---|---|---|
| Alt. 1 | No reduction in mobility or volume. Minimum to no reduction in toxicity. | Current access restrictions protect public. No current activity in building or near sump, so no current exposure to workers. | Requires no active implementation. Will require long-term security and maintenance of building if UMDA is closed. | No immediate costs. |
| Alt. 2 | Toxicity of sump sludge and water would be eliminated. No change in Washout Plant or sump toxicity, volume or mobility. | Current access restriction protect public. Should be slightly more effective (short-term) than other remediation alternatives because building is not remediated. | Easily implemented. Planning & Design = 6 months Implementation = approximately 30 years. | Initial (capital) cost about $55,000. Net present value (cost) over 30-year period about $220,000. |
| Alt. 3 | This alternative would reduce the volume and mobility of the contaminated materials. Toxicity would also be reduced by incinerating the hydroblasting sludge. | Building should contain any potential emissions (of hydroblast slurry) and proper protective clothing should protect the operators. | This alternative could readily be implemented using commercially available equipment. Planning & Design = 7 months, implementation = 12 months. | The total estimated planning, capital and operating cost for this alternative is about $890,000. |
| Alt. 4A & 4B | Destruction of explosives reduces toxicity and mobility to background levels. The volume of contaminated material is also reduced to nearly zero. | Workers, environment and community protected during operations by using proper safety procedures and process monitoring. Time to implement and complete remediation (including demonstration test) is estimated at 10 to 14 months. | Construction of custom built system would be required. A similar unit was operated at Cornhusker and Hawthorne AAPs. 12 to 16 months is estimated for planning, design, construction & demonstration test. Two months is estimated for actual remediation. | Capital cost is estimated at about $410,000. The total planning, capital and operating cost for Alternative 4A (with total demolition of bldg.) is estimated at $1,200,000. The total planning, capital, and operating cost for Alternative 4B (with partial demolition of the bldg) is estimated at about $1,100,000. |
| Alt. 5A & 5B | This alternative would not reduce the volume or toxicity of the contaminated materials (except concrete in Alt. 5B). Mobility of the explosive in the contaminated materials would be reduced by disposal in a landfill. | Emissions of contaminated concrete dust would have to be controlled by water spraying of concrete during demolition and transport. Protection to the workers would be provided by protective clothing. | This alternative could readily be implemented using commercially available equipment. Planning & Design = 10 months; Implementation: 5A = 3 months, 5B = 8-11 months. | There is little or no capital cost estimated for these alternatives. The planning and operating cost estimated for Alternative 5A is approximately $820,000 (no treatment of debris) and $1,200,000 for Alternative 5B (with incineration of concrete debris). |

Source: Arthur D. Little, Inc.

## Figure 4-3: Comparative Ranking of Alternatives

| Criteria | Alternative 1 No Action | Alternative 2 Controlled Access | Alternative 3 Hydroblasting, Demolition and Disposal | Alternative 4A Hot Gas Decontamination, Total Demolition and Disposal | Alternative 4B Hot Gas Decontamination, Partial Demolition and Disposal | Alternative 5A Demolition and Disposal of Contaminated Materials | Alternative 5B Demolition, Incineration of Concrete Rubble and Disposal of Materials |
|---|---|---|---|---|---|---|---|
| **Overall Protection of Human Health and the Environment** | Worst | Good | Good | Best | Best | Good | Good |
| **Compliance with ARARs** | Worst | Good | Good | Best | Best | Good | Good |
| **Long-Term Effectiveness** | Worst | Neutral | Good | Best | Best | Good | Good |
| **Reduction of Toxicity, Mobility, or Volume through Treatment** | Worst | Poor | Good | Best | Best | Poor | Good |
| **Short-Term Effectiveness** | Worst | Best | Good | Good | Good | Good | Good |
| **Implementability** | Best | Best | Best | Good | Good | Best | Best |
| **Cost (Capital and O&M)** | Best | Best | Good | Poor | Poor | Good | Poor |
| **Overall Rating** | Worst | Good | Good | Best | Best | Good | Good |

**Key**

● =Best ◓ =Good ◒ =Neutral ⊗ =Poor ○ =Worst

Source: Arthur D. Little, Inc.

the equipment, but Alternatives 3 and 5B would reduce the toxicity of the concrete rubble from the building. Alternatives 3 and 5B would also reduce the volume of contaminated material. All the alternatives (except 1) would reduce mobility of the explosive contaminants. Alternative 1 provides no reduction in toxicity, mobility, or volume of contaminated materials.

*Short-Term Effectiveness*. All the remedial alternatives (excluding Alternative 1) can be implemented in a year or less. Because the risks during implementation would be very low, there is no significant difference among these remedial alternatives in terms of short-term effectiveness. There are however, slightly less short-term risk associated with Alternative 2 than with the other remediation alternatives because there would be no remediation activities associated with the building or equipment that could result in any release.

*Implementability*. All of the alternatives are readily implementable from an administrative and technical standpoint. In terms of materials and services, however, Alternatives 4A and 4B would require additional time for construction and demonstration of the hot gas decontamination system.

*Cost*. The least costly (but still effective) remedial alternative is Sump Cleanout/Controlled Access with net present value (the value of money today spent over a period of time in the future) of approximately $220,000. Alternatives 3 and 5A would have a net present value (cost) of about $890,000 and $820,000 respectively while Alternatives 4A, 4B, and 5B would have a net present value cost of approximately $1 million each.

*Modifying Criteria*. In accordance with RI/FS guidance[3] the final two criteria involving state and community acceptance will be evaluated following the receipt of state agency and public comments on the FS and the Proposed Plan. The criteria are as follows:

- State (Support Agency) Acceptance – Reflects the State of Oregon's apparent preferences among or concerns regarding the alternatives.

- Community Acceptance – Reflects the local communities apparent preferences among or concerns about alternatives.

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## Appendix A: Sample Calculations

Appendix A
Sample Calculations

## 1. Washout Plant Estimated Concrete Surface and Volume

1.1 Concrete Surface Area

| | |
|---|---|
| Washout Building Floor | 81 ft. x 32 ft. = 2592 sq. ft. |
| 2 Pelletizer Building Floors | 2 x 22 ft. x 31 ft. = 1364 sq. ft. |
| Pelletizer Building Ceiling (1st Floor) | 22 ft. x 31 ft. = 682 sq. ft. |
| Blast Wall (Both Sides) | 2 x 40 ft. x 34 ft. = 2820 sq. ft. |
| Sump Walls (Outside) | 2 x 18 ft. x 7 ft. ht. + 2 x 10 ft. x 7 ft. ht. = 391 sq. ft. |
| Sump Walls (Inside) | 2 x 16 ft. x 6 ft. ht. + 2 x 8 ft. x 6 ft. ht. = 288 sq. ft. |
| Sump Floor (Inside & Outside) | (8 ft. x 16 ft. + 10 ft. x 18 ft.) = 308 sq. ft. |
| Total Concrete Surface Area | 8,455 sq. ft. |
| Round to | 8,500 sq. ft. |

1.2 Concrete Volume

| | |
|---|---|
| Washout Building Floor | 81 ft. x 32 ft. x 1 ft. thick = 2592 cu. ft. |
| 2 Pelletizer Building Floors | 2 x 22 ft. x 31 ft. x 1 ft. thick = 1364 cu. ft. |
| Blast Wall | 40 ft. x 34 ft. x 1 ft. thick = 1360 cu. ft. |
| Sump Walls | 2 x 16 ft. x 6 ft. x 1 ft. thick x 2 x 8 ft. x 6 ft. x 1 ft. thick = 288 cu. ft. |
| Sump Floor | 10 ft. x 18 ft. x 1 ft. thick = 180 cu. ft. |
| | 5,784 cu. ft. |
| Round to | 5,800 cu. ft. |

## 2. Washout Tanks External Surface and Volume

2.1 Washout Tanks External Surface Area (Figure 1-4)

| | |
|---|---|
| Washout Tank Sides | (4) (17 ft. x 6 ft.) = (4) (6 ft. x 6 ft.) = 502 sq. ft. |
| Washout Tank Bottom | (17 ft. x 6 ft.) = 102 sq. ft. |
| Settling Tank Sides | (4) (12 ft. x 5 ft.) + (4) (6 ft. x 5 ft.) = 230 sq. ft. |
| Recirculation Tank Sides | (2) (17 ft. x 2.5 ft.) + (2) (6 ft. x 2.5 ft.) = 115 sq. ft. |
| Recirculation Tank (False) Bottom | 17 ft. x 6 ft. = 102 sq. ft. |
| Total Surface Area | 1,613 sq. ft. |
| Round to | 1,610 sq. ft. |

2.2 Washout Tanks Total Volume (Figure 1-4)

| | |
|---|---|
| Washout Tanks | 17 ft. x 6 ft. x 6 ft. = 612 cu. ft. |
| Settling Tanks | 17 ft. x 6 ft. x 5 ft. = 510 cu. ft. |
| Recirculation Tank | 17 ft. x 6 ft. x 5 ft. = 510 cu. ft. |
| Total Washout Tank Volume | 1,632 cu. ft. |
| Round to | 1,630 cu. ft. |

# Appendix B: Addendum to the Human Health Baseline Risk Assessment Explosives Washout Plant

**DRAFT**

**Addendum to the**
**Human Health Baseline Risk Assessment**
**Explosives Washout Plant**
**Umatilla Depot Activity, Hermiston, Oregon**

Prepared for:

U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland
Contract NO. DAAA15-88-D-0008
Delivery Order No. 3

DAMES & MOORE
849 International Drive, Suite 320, Linthicum, Maryland 21090

August 16, 1993

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## LIST OF FIGURES



## LIST OF TABLES

# 1.0 INTRODUCTION

This document is an addendum to the Human Health Baseline Risk Assessment (RA) for the Umatilla Depot Activity (UMDA), Hermiston, Oregon (Dames & Moore, 1992a). It was prepared for the U.S. Army Environmental Center (AEC) under the Base Realignment and Closure (BRAC) Program, Contract No. DAAA15-88-D0008, Delivery Order No. 3. This addendum is conducted in support of the remedial investigation/feasibility study (RI/FS) for UMDA to verify and characterize contamination on the interior surfaces of the Explosives Washout Plant (EWP; Site 5) in terms of potential impacts to human health under current and future land use conditions.

The format of this addendum is similar to that of the Human Health Baseline RA (Dames & Moore, 1992a), with the exception that certain items common to both the Baseline RA and this addendum are not repeated in the present document. These items are referenced in the appropriate places in this addendum. The addendum consists of the following:

- <u>Section 1.0</u>--An introduction that presents the outline of the addendum, the objectives of the addendum, and a summary of the risk assessment process.
- <u>Section 2.0</u>--Installation background and description of the EWP.
- <u>Section 3.0</u>--Data evaluation and identification of contaminants of concern.
- <u>Section 4.0</u>--Environmental fate and transport properties of the contaminants of concern.
- <u>Section 5.0</u>--Toxicity assessment of the contaminants of concern.
- <u>Section 6.0</u>--Exposure assessment.
- <u>Section 7.0</u>--Risk characterization and an evaluation of uncertainties.
- <u>Section 8.0</u>--Preliminary remediation goals.
- <u>Section 9.0</u>--Summary and conclusions.
- <u>Section 10.0</u>--References.

## 1.1 OBJECTIVES OF THE ADDENDUM

The objectives of this addendum are to assess the potential present and future health risks posed by contaminants on the interior surfaces of the EWP in the absence of remediation, and to develop preliminary remediation goals (PRGs) for the interior surfaces of the EWP.

## 1.2 BASELINE RA PROCESS

The principal components of the Baseline RA are the following:

- Contaminant assessment/data evaluation
- Environmental fate and transport
- Toxicity assessment
- Exposure assessment
- Risk characterization
- Development of PRGs.

A detailed discussion of the methods used to implement each of these components is provided in Section 1.2 of the Baseline RA (Dames & Moore, 1992a) and is not repeated herein.

# 2.0 INSTALLATION BACKGROUND AND SITE DESCRIPTION

## 2.1 INSTALLATION BACKGROUND

Installation background information--including UMDA location and physical setting and UMDA history, present mission, and future use--is provided in Section 2.1 of the Baseline RA (Dames & Moore, 1992a) and is not repeated herein.

## 2.2 DESCRIPTION OF THE EXPLOSIVES WASHOUT PLANT

The EWP is designated as Site 5, Building 489 and is located in the central portion of UMDA (see Plate 1, Area V in the Baseline RA (Dames & Moore, 1992a)). The EWP consists of two adjoining parts--a large single-story room where washout operations occurred, and a two-story flaker addition where explosives sludges were separated, dried, and pelletized. Explosive washout operations conducted from the mid-1950s to the mid-1960s involved the removal of explosives from munitions, bombs, and projectiles by means of water or steam-cleaning techniques. Some of the munitions demilitarized at this location included 500- and 750-pound Composition B and TNT and reportedly some tritonal. Former employees indicated that Building 489 was torn down in the 1950s for renovation and equipment modernization and was then reconstructed in the same location.

A detailed discussion on the operations conducted at the EWP is presented in Section 4.2.1.1 of the RI (Dames & Moore, 1992b).

# 3.0 DATA EVALUATION AND IDENTIFICATION OF CONTAMINANTS OF CONCERN

## 3.1 INTRODUCTION

Section 3.0 identifies the site- and medium-specific chemicals that are likely to be site-related and have reportable concentrations of acceptable quality for use in this addendum to the Baseline RA. The rationale for selection of contaminants of concern is provided in Section 3.1 of the Baseline RA (Dames & Moore, 1992a) and is not repeated herein. The nature and extent of contamination at Site 5, the EWP, is presented and evaluated in the RI (Dames & Moore, 1992b) and is not repeated herein. Section 3.2 identifies the site-specific contaminants for the interior surfaces of the EWP.

## 3.2 SITE 5–EXPLOSIVES WASHOUT PLANT

Ten wipe samples were collected from the interior surfaces of the EWP and analyzed for explosives (see Figure 3-1). The wipe sample analytical results are presented in Table 3-1. As indicated in Table 3-1, four explosives–1,3,5-tinitrobenzene (TNB), 2,4,6-trinitrotoluene (TNT), RDX(hexahydro-1,3,5-trinitro-1,3,4-triazine),andHMX(cyclotetramethylenetetranitramine)–were detected in the wipe samples. These four explosives are selected as contaminants of concern.

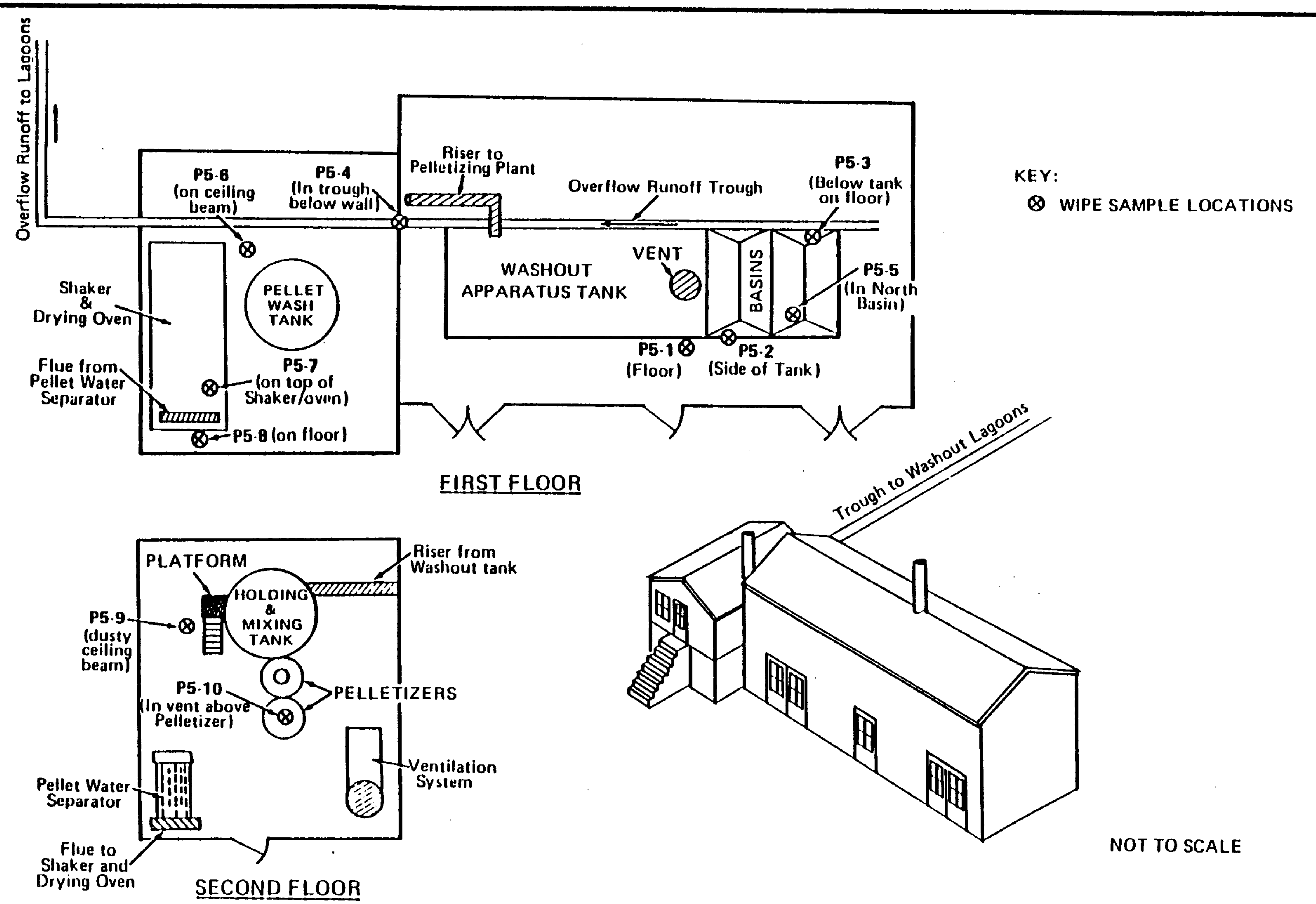


FIGURE 3–1
WIPE SAMPLE LOCATIONS AT
SITE 5, EXPLOSIVE WASHOUT PLANT

Dames & Moore

## TABLE 3-1

### Wipe Sample Analytical Results
### Site 5, Explosives Washout Plant (Building 489)

Site 5 Building Wipes – 8/9/91

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| SITEID | | P05A001 | P05A010 | P05A002 | P05A003 | P05A004 | P05A005 | P05A006 | |
| FIELD ID | | UMWP*1 | UMWP*10 | UMWP*2 | UMWP*3 | UMWP*4 | UMWP*5 | UMWP*6 | |
| S. DATE | | 15-nov-1990 | 15-nov-1990 | 15-nov-1990 | 15-nov-1990 | 15-nov-1990 | 15-nov-1990 | 15-nov-1990 | |
| DEPTH | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| MATRIX | | CBI | CBI | CBI | CBI | CBI | CBI | CBI | |
| UNITS | *CRLs* | UGC2 | UGC2 | UGC2 | UGC2 | UGC2 | UGC2 | UGC2 | *COMPARISON CRITERIA* |
| **Explosives** | | | | | | | | | |
| 135TNB | *0.024* | LT 0.024 | LT 0.024 | LT 0.024 | LT 0.024 | LT 0.024 | LT 0.024 | LT 0.024 | *NSA* |
| 246TNT | *0.023* | [ 0.256 ] | [ 0.03 ] | LT 0.023 | [ 0.132 ] | [ 0.029 ] | [ 0.207 ] | [ 8.4 ] | *NSA* |
| HMX | *0.033* | [ 0.049 ] | LT 0.033 | LT 0.033 | LT 0.033 | LT 0.033 | [ 0.048 ] | [ 1.84 ] | *NSA* |
| RDX | *0.029* | [ 0.304 ] | LT 0.029 | [ 0.338 ] | [ 0.084 ] | LT 0.029 | [ 0.151 ] | [ 17.6 ] | *NSA* |

Site 5 Building Wipes – 8/9/91

| | | | | | |
|---|---|---|---|---|---|
| SITEID | | P05A007 | P05A008 | P05A009 | |
| FIELD ID | | UMWP*7 | UMWP*8 | UMWP*9 | |
| S. DATE | | 15-nov-1990 | 15-nov-1990 | 15-nov-1990 | |
| DEPTH | | 0.0 | 0.0 | 0.0 | |
| MATRIX | | CBI | CBI | CBI | |
| UNITS | *CRLs* | UGC2 | UGC2 | UGC2 | *COMPARISON CRITERIA* |
| **Explosives** | | | | | |
| 135TNB | *0.024* | LT 0.024 | LT 0.024 | [ 0.032 ] | *NSA* |
| 246TNT | *0.023* | [ 0.304 ] | [ 2.7 ] | [ 0.349 ] | *NSA* |
| HMX | *0.033* | LT 0.033 | LT 0.033 | [ 0.271 ] | *NSA* |
| RDX | *0.029* | LT 0.029 | [ 0.057 ] | [ 0.064 ] | *NSA* |

GT = Greater Than
LT = Less Than
NA = Not Available

ND = Not Detected
NSA = No Standard Available
NT = Not Tested

[ ] = Detected concentration exceeds comparison criterion
C = Confirmed Result
U = Unconfirmed Result

## 4.0 ENVIRONMENTAL FATE AND TRANSPORT PROPERTIES

Potential human and environmental exposure to each of the contaminants of concern is influenced by physical/chemical properties and the environmental fate and transport properties of each contaminant. A summary of the important physical/chemical and environmental fate parameters for the contaminants of concern is provided in Table 4-1 of the Baseline RA (Dames & Moore, 1992a). Fate and transport profiles for each of the contaminants of concern are presented in Appendix C of the Baseline RA (Dames & Moore, 1992a).

## 5.0 TOXICITY ASSESSMENT

The purpose of the toxicity assessment is twofold:

- To weigh available evidence regarding the potential for particular contaminants to cause adverse effects in exposed individuals.

- To estimate, where possible, the relationship between the extent of exposure to a contaminant and the increased likelihood or severity of adverse effects.

A toxicity assessment of contaminants of concern is presented in Section 5.0 of the Baseline RA (Dames & Moore, 1992a) and is not repeated herein. A summary of toxicity factors for the contaminants of concern is provided in Tables 5-1 and 5-2 of the Baseline RA (Dames & Moore, 1992a). Toxicity profiles for each of the contaminants of concern, which discuss the derivation of each of the toxicity parameters, are presented in Appendix D of the Baseline RA (Dames & Moore, 1992a).

## 6.0 EXPOSURE ASSESSMENT

The objective of the exposure assessment is to estimate the type and magnitude of exposures to the contaminants of concern that are present at or migrating from a site. First, the exposure setting is characterized by evaluating current and future land use scenarios. Then exposure pathways by which populations may be exposed are identified, based on the previously identified land uses and evaluation of the sources, releases, types, and locations of the contaminants at the site.

In this section, potential pathways are identified that could result in human exposure to the contaminants of concern on the interior surfaces of the EWP. Potential pathways are evaluated for two land use scenarios--current and future. The pathways selected for quantitative analysis include those that are considered to represent the greatest potential for human exposure. Exposure point concentrations and daily uptake for each contaminant of concern are also estimated.

### 6.1 LAND USE SCENARIOS

The current land use scenario considers the existing land use patterns of the area and then evaluates the completeness of potential exposure pathways based on current land use information. For the future land use scenario, the exposure pathways are altered to reflect the effects of possible future changes. The current and future land uses scenarios for the EWP are discussed below. Because this addendum is limited to explosives contamination on the interior building surfaces of the EWP, off-post areas would not be affected.

#### 6.1.1 Current Land Uses

No operations currently take place in the EWP; therefore, no UMDA employees are expected to be onsite. Security personnel do not routinely enter this site while on patrol.

#### 6.1.2 Future Land Uses

Under current provisions of the Department of Defense (DOD) Base Realignment and Closure Program, UMDA may be closed and the land may be made available for private sale and use. The excessed land could be developed for a variety of uses, causing human exposures to contaminants of concern that are not applicable under current land use conditions. The most likely

future use of the EWP is for light industrial or military purposes; however, because no restrictions are in place regarding potential future use of the EWP, residential use, although unlikely, will also be considered a potential future land use. Future populations that may be exposed to contaminants of concern on the interior surfaces of the EWP include industrial workers, military personnel, or residents.

## 6.2 IDENTIFICATION OF POTENTIAL HUMAN EXPOSURE PATHWAYS

This section discusses the potential pathways by which the human populations identified above may be exposed to contaminants of concern on the interior surfaces of the EWP. An exposure pathway is composed of a contaminant source, a release mechanism or transport medium by which the contaminant is transported to the location of exposure, an exposure route by which the contaminant enters the receptor's body, and a potential receptor. If all four components of an exposure pathway are present, the pathway is considered to be complete. If one or more of the four components of an exposure pathway are not present, the pathway is considered to be incomplete.

Because no receptors have been identified for the current land use scenario, there are no complete exposure pathways under the current land use scenario.

Based on an evaluation of future land uses and the presence of explosives contamination on the interior surfaces of the EWP, the following three potential exposure pathways are identified for the future land use scenario and will be quantitatively evaluated:

- Direct dermal contact with contaminated surfaces and subsequent absorption of contaminants through the skin.
- Inadvertent ingestion of contaminated dust.
- Inhalation of airborne dust.

## 6.3 METHODOLOGY TO QUANTIFY SELECTED EXPOSURE PATHWAYS

The U.S. Environmental Protection Agency (USEPA) does not currently have established guidance regarding the quantification of potential exposure to contaminated interior surfaces. Technical guidance issued by the New Jersey Department of Environmental Protection (NJDEP) on development of numerical cleanup criteria for protection of human health from exposure to

contaminated building interior surfaces (NJDEP, 1992), was reviewed and determined to be applicable to the EWP. The numerical criteria developed using the NJDEP guidance represent maximum concentrations of chemicals that could be present on contaminated surfaces without adverse human health effects from long-term habitation or use of a building in industrial or residential settings. The routes of exposure considered are dermal absorption, incidental ingestion, and inhalation of toxic chemical contamination on interior non-porous and porous surfaces. These three exposure pathways were identified as being potentially complete for the future land use scenario at the EWP (see Section 6.2).

The NJDEP guidance makes use of standard USEPA exposure assumptions, where appropriate. The equations developed by NJDEP for calculating cleanup criteria can be rearranged to calculate potential risks and/or hazards associated with a given concentration of a contaminant on building interior surfaces. Therefore, the methodology provided in the NJDEP guidance is applied to the EWP to calculate potential risks and hazards associated with dermal contact, incidental ingestion, and inhalation of dust in the EWP. As discussed above, the NJDEP methodology is applicable to both residential and industrial land use scenarios.

The risk assessment for building interior surfaces developed by NJDEP and applied to the EWP are based on the following exposure assumptions:

- Twenty-five percent of the surface area below 6 feet in height of a room 10 x 12 x 8 feet is assumed to contribute to a dose by the dermal, ingestion, and inhalation routes over a lifetime. One percent of the area above 6 feet contributes to a dose by the same routes.

- The area below 6 feet is assumed to be accessible and the area above 6 feet is assumed to be inaccessible. The standards for the inaccessible surfaces (above 6 feet) are two times the standard for accessible surfaces (below 6 feet); the standards for accessible surfaces are more stringent because they are more accessible than those above 6 feet.

- Fifty percent of the contamination on these surfaces is assumed to be transferred to a human receptor and, therefore, to be the dose.

- A body weight of an adult male (70 kg) is assumed.

- A lifetime length of 70 years and an exposure frequency of 365 days/year are assumed for Class A, B, and C carcinogens. These represent residential exposure conditions.

- For noncarcinogenic effects, an industrial time factor of 0.673 (five-day work week and 49-week work year) and length of time at the site of 9125 days (25 days x 365 days per year) are assumed. The industrial, rather than a residential, time period is used for noncarcinogenic effects because it is more stringent.

Rearranging the equation generated by NJDEP for calculating cleanup criteria to solve for absorbed dose yields:

$$\textit{Absorbed dose } (mg/kg/day) = \frac{CS \times F \times (AC + (AD \times IN))}{BW \times AT}$$

where:

CS = Exposure point chemical concentration on interior surfaces ($mg/cm^2$)
F = Fraction of contamination which results in exposure to an individual (assumed to be 0.5)
AC = Accessible area of the room (8.9 $m^2$)
AD = Adjustment to allow for criteria above 6 feet to be twice as high as below 6 feet (2)
IN = Inaccessible area of the room (0.19 $m^2$)
BW = Body weight of an adult male (70 kg)
AT = Averaging time for carcinogenic effects: 70 years x 365 days/year = 25,550 days, representing residential exposure; Averaging time for noncarcinogenic effects: 0.673 x 9125 days = 6141 days, representing industrial exposure.

Although NJDEP includes a factor for mean dietary intake for noncarcinogenic effects, the mean dietary intake for explosives is assumed to be zero.

The risk assessment calculations are performed using three exposure point concentrations--the maximum detected chemical concentration, the 95 percent upper confidence limit (UCL) on the

arithmetic mean of chemical concentrations detected, and the 95 percent UCL on the arithmetic mean of samples except for the maximum detected concentration. Three exposure point concentrations are used because one wipe sample (P5-6 collected from the top of the pelletizer building beam) had much higher chemical concentrations than the other wipe samples; therefore, the use of three exposure point concentrations presents a range of potential exposures.

## 6.4 ESTIMATED HUMAN EXPOSURE CONCENTRATIONS AND CONTAMINANT INTAKES

Quantitative estimates of human exposure point concentrations and contaminant intakes calculated according to the methodology presented in Section 6.3 for the future land use scenario are provided in this section. Exposure point concentrations for the interior surfaces of the EWP are obtained from Table 3-1.

Tables 6-1, 6-2, and 6-3 present exposure point concentrations--maximum, 95% UCL, and 95% UCL without the maximum, respectively--carcinogenic intakes, and noncarcinogenic intakes estimated for exposure to contamination on the interior surfaces of the EWP (Bldg. 489) via dermal contact, incidental ingestion, and inhalation.

TABLE 6-1

**Exposure Point Concentrations and Estimated Human Intakes Due to Exposure to the Interior Building Surfaces of the Explosives Washout Plant (Bldg. 489) Using Maximum Detected Concentrations in Wipe Samples**

| Analyte | Exposure Point Concentration (mg/m2) | Carcinogenic Intake (mg/kg/day) | Noncarcinogenic Intake (mg/kg/day) |
|---|---|---|---|
| 135TNB | 3.20E-01 | -- | 3.46E-06 |
| 246TNT | 8.40E+01 | 2.18E-04 | 9.07E-04 |
| HMX | 1.84E+01 | -- | 1.99E-04 |
| RDX | 1.76E+02 | 4.56E-04 | 1.90E-03 |

"--" - Not calculated because contaminant is not considered a carcinogen or slope factor is not available.

TABLE 6-2

**Exposure Point Concentrations and Estimated Human Intakes Due to Exposure to the Interior Building Surfaces of the Explosives Washout Plant (Bldg. 489) Using 95% UCL on Arithmetic Mean of Concentrations in Wipe Samples**

| Analyte | Exposure Point Concentration (mg/m2) | Carcinogenic Intake (mg/kg/day) | Noncarcinogenic Intake (mg/kg/day) |
|---|---|---|---|
| 135TNB | 2.63E-01 | -- | 2.84E-06 |
| 246TNT | 2.77E+01 | 7.17E-05 | 2.99E-04 |
| HMX | 5.69E+00 | -- | 6.15E-05 |
| RDX | 5.07E+01 | 1.31E-04 | 5.48E-04 |

'--' - Not calculated because contaminant is not considered a carcinogen or slope factor is not available.

TABLE 6-3

Exposure Point Concentrations and Estimated Human Intakes
Due to Exposure to the Interior Building Surfaces of the Explosives Washout Plant (Bldg. 489)
Using 95% UCL on Arithmetic Mean of Concentrations Other Than the Maximum in Wipe Samples

| Analyte | Exposure Point Concentration (mg/m2) | Carcinogenic Intake (mg/kg/day) | Noncarcinogenic Intake (mg/kg/day) |
|---|---|---|---|
| 135TNB | 2.40E-01 | -- | 2.59E-06 |
| 246TNT | 9.77E+00 | 2.53E-05 | 1.06E-04 |
| HMX | 1.11E+00 | -- | 1.20E-05 |
| RDX | 1.95E+00 | 5.05E-06 | 2.11E-05 |

'--' - Not calculated because contaminant is not considered a carcinogen or slope factor is not available.

# 7.0 RISK CHARACTERIZATION

## 7.1 METHODOLOGY

The methodology for calculating potential carcinogenic risks and noncarcinogenic hazards is presented in detail in Section 7.1 of the Baseline RA (Dames & Moore, 1992a) and is not repeated herein.

## 7.2 CALCULATED POTENTIAL RISKS AND HAZARDS FOR THE EWP

Tables 7-1, 7-2, and 7-3 present the carcinogenic intakes, noncarcinogenic intakes, slope factors, reference doses, potential risks, and potential hazards, as applicable, for the maximum, 95% UCL, and 95% UCL without the maximum exposure point concentrations, respectively, for exposure to contamination on the interior surfaces of the EWP (Bldg. 489) via dermal contact, incidental ingestion, and inhalation.

As indicated in Table 7-1, the total carcinogenic risk and noncarcinogenic hazard using the maximum detected concentrations are 6E-05 and 3E+00, respectively. The total carcinogenic risk and noncarcinogenic hazard using the 95% UCL (Table 7-2) are 2E-05 and 8E-01, respectively. The total carcinogenic risk and noncarcinogenic hazard using the 95% UCL without the maximum (Table 7-3) are 1E-06 and 3E-01, respectively.

## 7.3 EVALUATION OF UNCERTAINTIES

As discussed in the Risk Assessment Guidance for Superfund (RAGS; USEPA, 1989), the risk measures used in Superfund site risk assessments are not fully probabilistic estimates of risk, but rather are conditional estimates based on a considerable number of assumptions about exposure and toxicity. An analysis of general and site specific uncertainties is presented in detail in Section 7.5 of the Baseline RA (Dames & Moore, 1992a) and is not repeated herein. Uncertainties associated with exposure parameter values for the intake calculation presented in this addendum are briefly described in this section.

Several uncertainties are associated with the exposure parameters used to estimate intakes, which are ultimately combined with toxicological information to calculate risks, hazards, and PRGs. Uncertainties associated with general exposure parameters are discussed in Section 7.5.5

TABLE 7–1

Potential Carcinogenic Risks and Noncarcinogenic Hazards
Due to Exposure to the Interior Building Surfaces of the Explosives Washout Plant (Bldg. 489)
Using Maximum Detected Concentrations in Wipe Samples

| Analyte | Carcinogenic Intake (mg/kg/day) | Slope Factor 1/(mg/kg/day) | Risk |
|---|---|---|---|
| 135TNB | -- | -- | -- |
| 246TNT | 2.18E–04 | 3.0E–02 | 7E–06 |
| HMX | -- | -- | -- |
| RDX | 4.56E–04 | 1.1E–01 | 5E–05 |
| **Total** | | | 6E–05 |

| Analyte | Noncarcinogenic Intake (mg/kg/day) | Reference Dose (mg/kg/day) | Hazard Quotient |
|---|---|---|---|
| 135TNB | 3.46E–06 | 5.0E–05 | 7E–02 |
| 246TNT | 9.07E–04 | 5.0E–04 | 2E+00 |
| HMX | 1.99E–04 | 5.0E–02 | 4E–03 |
| RDX | 1.90E–03 | 3.0E–03 | 6E–01 |
| **Total** | | | 3E+00 |

"--" – Not calculated because contaminant is not considered a carcinogen or slope factor is not available.

TABLE 7-2

Potential Carcinogenic Risks and Noncarcinogenic Hazards
Due to Exposure to the Interior Building Surfaces of the Explosives Washout Plant (Bldg. 489)
Using 95% UCL on Arithmetic Mean of Concentrations in Wipe Samples

| Analyte | Carcinogenic Intake (mg/kg/day) | Slope Factor 1/(mg/kg/day) | Risk |
|---|---|---|---|
| 135TNB | -- | -- | -- |
| 246TNT | 7.17E-05 | 3.0E-02 | 2E-06 |
| HMX | -- | -- | -- |
| RDX | 1.31E-04 | 1.1E-01 | 1E-05 |
| Total | | | 2E-05 |

| Analyte | Noncarcinogenic Intake (mg/kg/day) | Reference Dose (mg/kg/day) | Hazard Quotient |
|---|---|---|---|
| 135TNB | 2.84E-06 | 5.0E-05 | 6E-02 |
| 246TNT | 2.99E-04 | 5.0E-04 | 6E-01 |
| HMX | 6.15E-05 | 5.0E-02 | 1E-03 |
| RDX | 5.48E-04 | 3.0E-03 | 2E-01 |
| Total | | | 8E-01 |

"--" – Not calculated because contaminant is not considered a carcinogen or slope factor is not available.

TABLE 7–3

Potential Carcinogenic Risks and Noncarcinogenic Hazards
Due to Exposure to the Interior Building Surfaces of the Explosives Washout Plant (Bldg. 489)
Using 95% UCL on Arithmetic Mean of Concentrations Other Than the Maximum in Wipe Samples

| Analyte | Carcinogenic Intake (mg/kg/day) | Slope Factor 1/(mg/kg/day) | Risk |
|---|---|---|---|
| 135TNB | -- | -- | -- |
| 246TNT | 2.53E–05 | 3.0E–02 | 8E–07 |
| HMX | -- | -- | -- |
| RDX | 5.05E–06 | 1.1E–01 | 6E–07 |
| **Total** | | | 1E–06 |

| Analyte | Noncarcinogenic Intake (mg/kg/day) | Reference Dose (mg/kg/day) | Hazard Quotient |
|---|---|---|---|
| 135TNB | 2.59E–06 | 5.0E–05 | 5E–02 |
| 246TNT | 1.06E–04 | 5.0E–04 | 2E–01 |
| HMX | 1.20E–05 | 5.0E–02 | 2E–04 |
| RDX | 2.11E–05 | 3.0E–03 | 7E–03 |
| **Total** | | | 3E–01 |

"--" – Not calculated because contaminant is not considered a carcinogen or slope factor is not available.

of the Baseline RA (Dames & Moore, 1992a). In addition to exposure parameter uncertainties discussed in the Baseline RA, uncertainties are also associated with the pathway specific exposure assumptions presented in Section 6.3. For example, there are uncertainties associated with the surface area assumed to be available for contact and the percentage of contamination assumed to be transferred to a receptor. Although conservative exposure assumptions were selected by NJDEP, there is a moderate degree of uncertainty associated with the selected exposure assumptions.

## 8.0 PRELIMINARY REMEDIATION GOALS

Preliminary remediation goals (PRGs) are calculated by rearranging the equations used to calculate the risks and hazards to solve for the acceptable surface concentration. As per the methodology provided in the NJDEP guidance which has been applied to the EWP, a risk level of 1E-05 is selected as the target risk level for Class C carcinogens (RDX and 2,4,6-TNT). For noncarcinogenic effects, the reference dose is the target daily intake level. In addition, as specified in the NJDEP guidance, criteria for inaccessible surfaces are calculated as two times the criteria for accessible surfaces.

Using these assumptions, and the assumptions previously presented in Section 6.3, PRGs are calculated for the interior building surfaces of the EWP and are presented in Table 8-1. As previously discussed in Section 6.3, the numerical criteria developed using NJDEP guidance are applicable to both residential and industrial land use scenarios.

A review of the PRGs presented in Table 8-1 with the wipe sample analytical results presented in Table 3-1 indicates that only RDX in sample P5-6 (top of pelletizer building beam) exceeds the carcinogenic PRGs. RDX was detected in this sample at a concentration of 17.6 $\mu g/cm^2$, whereas the PRG for inaccessible surfaces for RDX at a 1E-05 risk level is 7 $\mu g/cm^2$. However, the 95% UCL for RDX is below its PRG for inaccessible surfaces. 2,4,6-TNT was not detected in any samples exceeding its carcinogenic PRG.

None of the detections of 1,3,5-TNB, HMX, and RDX exceed the noncarcinogenic PRGs developed for both accessible and inaccessible surfaces. The concentration of 2,4,6-TNT detected in sample P5-6 (8.4 $\mu g/cm^2$) exceeds the noncarcinogenic PRG for accessible surfaces but not for inaccessible surfaces. Because this sample was collected from the top of a building beam, the inaccessible PRG appears to be more appropriate; therefore, this sample does not exceed its PRG.

TABLE 8-1

Preliminary Remediation Goals for the Explosives Washout Plant (Bldg. 489)
Interior Building Surfaces

| | Accessible Surfaces (below 6 feet) | | | |
|---|---|---|---|---|
| | Carcinogenic PRG (1E-05 risk level) | | Noncarcinogenic PRG (Hazard Index of 1) | |
| Analyte | (mg/m2) | (ug/cm2) | (mg/m2) | (ug/cm2) |
| 135TNB | -- | -- | 4.63 | 0.46 |
| 246TNT | 128 | 12.8 | 46.3 | 4.63 |
| HMX | -- | -- | 4632 | 463 |
| RDX | 35 | 3.5 | 278 | 27.8 |

| | Inaccessible Surfaces (above 6 feet) | | | |
|---|---|---|---|---|
| | Carcinogenic PRG (1E-05 risk level) | | Noncarcinogenic PRG (Hazard Index of 1) | |
| Analyte | (mg/m2) | (ug/cm2) | (mg/m2) | (ug/cm2) |
| 135TNB | -- | -- | 9.26 | 0.92 |
| 246TNT | 256 | 25.6 | 92.6 | 9.26 |
| HMX | -- | -- | 9264 | 926 |
| RDX | 70 | 7 | 556 | 55.6 |

'--' - Not calculated because contaminant is not considered a carcinogen or slope factor is not available.

## 9.0 SUMMARY AND CONCLUSIONS

This addendum to the Human Health Baseline RA (Dames & Moore, 1992a) addresses potential risks and hazards to human health posed by contaminants on the interior surfaces of the EWP in the absence of remedial action. The main components and major conclusions of this addendum are summarized below.

- Based on wipe sample analytical results, four explosives–1,3,5-TNB, 2,4,6-TNT, RDX, and HMX–are selected as contaminants of concern for the interior building surfaces of the EWP.

- No receptors were identified for the current land use scenario. Future populations that may be exposed to contaminants of concern on the interior surfaces of the EWP include industrial workers, military personnel, or residents.

- Because no receptors have been identified for the current land use scenario, there are no complete exposure pathways under the current land use scenario. Three potential exposure pathways are identified for future land use scenarios: dermal contact with contaminated surfaces with subsequent absorption of contaminants through skin, inadvertent ingestion of contaminated dust, and inhalation of airborne dust.

- Because USEPA does not currently have established guidance regarding the quantification of potential exposure to contaminated interior surfaces, technical guidance issued by the NJDEP on development of numerical cleanup criteria for protection of human health from exposure to contaminated building interior surfaces (NJDEP, 1992) was used to calculate risks and hazards posed by contaminants on the interior surfaces of the EWP. The NJDEP methodology is applicable to both residential and industrial land use scenarios and considers the dermal absorption, incidental ingestion, and inhalation exposure routes.

- The risk assessment calculations are performed using three exposure point concentrations–the maximum detected chemical concentration, the 95 percent upper confidence limit (UCL) on the arithmetic mean of chemical concentrations detected.

and the 95 percent UCL on the arithmetic mean of samples except for the maximum detected concentration. Three exposure point concentrations are used because one wipe sample (P5-6 collected from the top of the pelletizer building beam) had much higher chemical concentrations than the other wipe samples; therefore, the use of three exposure point concentrations presents a range of potential exposures.

- The total carcinogenic risk and noncarcinogenic hazard using the maximum detected concentrations are 6E-05 and 3E+00, respectively. The total carcinogenic risk and noncarcinogenic hazard using the 95% UCL are 2E-05 and 8E-01, respectively. The total carcinogenic risk and noncarcinogenic hazard using the 95% UCL without the maximum are 1E-06 and 3E-01, respectively.
- Preliminary remediation goals (PRGs) are calculated by rearranging the equations used to calculate the risks and hazards to solve for the acceptable surface concentration. The PRGs developed are applicable to both residential and industrial land use scenarios.
- 2,4,6-TNT was not detected in any samples exceeding its carcinogenic PRG.
- Although the maximum concentration of RDX detected in wipe samples exceeds its carcinogenic PRG, the 95% UCL for RDX is below its PRG for inaccessible surfaces.
- None of the detections of 1,3,5-TNB, HMX, and RDX exceed the noncarcinogenic PRGs developed for both accessible and inaccessible surfaces.
- The concentration of 2,4,6-TNT detected in sample P5-6 (8.4 $\mu g/cm^2$) exceeds the noncarcinogenic PRG for accessible surfaces but not for inaccessible surfaces. Because this sample was collected from the top of a building beam, the inaccessible PRG appears to be more appropriate; therefore, this sample does not exceed its PRG.

## 10.0 REFERENCES


Dames & Moore, 1992a. Human Health Baseline Risk Assessment, Umatilla Depot Activity, Hermiston, Oregon, prepared for USATHAMA, Contract No. DAAA15-88-D-0008, August 25, 1992.

Dames & Moore, 1992b. Remedial Investigation Report for the Umatilla Depot Activity, Hermiston, Oregon, prepared for USATHAMA, Contract No. DAAA15-88-D-0008, August 21, 1992.

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